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# **The Development of an Integrated Management System in the Personal Care Products Industry**

By

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Thesis submitted in partial fulfilment of the requirements for the degree:

**Master of Science in Engineering  
(Chemical Engineering)**

**at the Department of Process Engineering  
University of Stellenbosch**

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**Stellenbosch**

April 2005

## i. Declaration

I, the undersigned, hereby declare that the work presented in this thesis is my own original work except where acknowledged in the text. Furthermore, neither this entire thesis, nor part thereof, has been submitted previously for a degree at any university.

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Kieren A Wilkie

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Date



## ii. Synopsis

More and more companies are realising the benefits of implementing management systems, integration of these systems would lead to a more efficient and effective management system.

Environmental, quality, health and safety management systems are discussed as well as how each is implemented independently. Where the systems overlap or have common goals, in order to avoid duplication and unnecessary extra work, the development and implementation as an integrated management system (IMS) is essential and forms the major part of this project. A long term plan to implement the IMS is developed and will be implemented in this company through stages.

A holistic approach is being used to improve not only the effluent but also the process and raw materials. The company being focussed on is broken down into different sections and each section carefully investigated to find possible process improvements. The company is looking to become as automated as possible to reduce human error, but due to financial concerns, everything is to be done as economically as possible, or over a longer time span.

The company is looking to implement an environmental management system (EMS) to become ISO 14000 certified and a quality management system (QMS) to become ISO 9000 certified as this would:

- improve product marketing,
- minimise long term costs,
- ensure the future development of the company, and
- help give the company an edge in the highly competitive market.

A brief background of the organisation is given in order to determine the current (pre-implementation) status of the company.

The EMS, QMS and Operational Health and Safety are discussed as well as how each is implemented independently. A gap analysis of each of the management systems is carried out and where the systems overlap or have common goals, these systems are integrated.

The different functional departments of the organisation nl. inventory, production and administration are investigated and suggestions on how to improve these are documented. These suggestions are to be carried out first as these are the most obvious and currently cause the most problems. Once these problems are fixed, the gap analysis of each system is to be looked at and implemented.

The water use of the organisation is investigated and some practical ways of decreasing the water use are suggested. Different ways of treating the effluent is discussed and it is decided that the best setup would be two tanks in series, including a flow equalisation tank and a chemical neutralisation tank. Depending on the pilot plant investigation an extra tank can be used to improve the water quality.

One of the fundamental foundations to an effective and efficient management system is management commitment and the management at AIC are not committed enough. Employees should be motivated through fair pay, training and recognition as this will reduce human error and also improve the general feeling in the organisation. The IMS will be greatly enhanced if business ethics and social responsibilities are incorporated.

Training seems to be the major problem in the organisation at present and once the appropriate sections of the IMS have been completed, training should become part of the company's routine.

### iii. Acknowledgements

I would like to express my sincerest gratitude to the following people and institutions for their assistance during the course of the thesis:

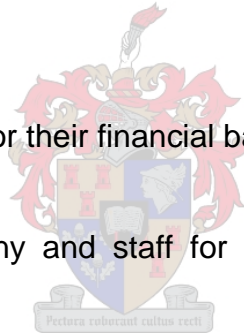
Prof . L. Lorenzen without his guidance, advice and support, none of this would have been possible

The staff at the Department of Process Engineering (US) for their assistance in different aspects of the project

The staff at Techpros (Stellenbosch) for their most valuable assistance, advice and the opportunity to help implement an environmental management system for an organisation.

The University of Stellenbosch for their financial backing

Antiseptol International Company and staff for their financial aid, patience and support.



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## iv. Nomenclature

AIC – Antiseptol International Company (Pty) Ltd

EMR – Environmental Management Representative

EMS – Environmental Management System

HSR – Health and Safety Representative

ISO – International Organisation for Standardisation

LD<sub>50</sub> – Lethal Dose (The concentration of a substance in waste which would kill 50 percent of the test population)

MSDS – Material Safety Data Sheet

OH&S – Operational Health and Safety

OHSAS – Operational Health and Safety Assessment

SABS – South African Bureau of Standards

TSS – Total Suspended Solids

QMS – Quality Management System

✘ Aspect or current problem

✓ Suggestion in response to the aspect or problem



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# 1. Introduction

As more and more companies realise the benefits of implementing management systems such as ISO 9000, ISO 14000, HACCP etc., these systems are becoming increasingly popular. With this increased popularity, companies want to implement more systems to become compliant in every aspect of their business.

If done incorrectly, this could lead to a great burden on the company, overloading their employees with more and more paperwork for each management system adopted. The costs also increase as more systems are implemented and need to be maintained. This problem can be resolved by correct integration, implementation and control of various management systems. Integration of these systems would lead to a more efficient and effective management system and would also decrease the associated costs.

Implementation, let alone integration is not always easy, especially for a) **large companies** which have not had any systems in place as there will need to be a large amount of work and resources to get a system implemented and b) **companies in their growth stage** as they will be trying to implement management systems with limited resources and expertise.

As most systems these days have the same backbone of process innovation and improvement, most currently used systems bring across a message of prevention is better than cure. An Environmental System's main aim is to preserve the environment. A Quality System's aim to prevent the product from being out of specification and have the customer satisfied first time every time and Operational Health and Safety tries to prevent injury or damage to everyone concerned with the company

These three systems are discussed as well as how each is implemented independently. Where the systems overlap or have common goals, in order to

avoid duplication and unnecessary extra work, the development and implementation as an integrated system is essential in order to minimise cost, time and accidents and forms the major part of this project. A long term plan with many suggestions to help implement the integrated system is developed and proposed.

A holistic approach is being used to improve not only the effluent but also the process and raw materials. The company being focussed on is broken down into different sections and each section carefully investigated to find possible scientific process improvements in order to improve quality, safety and to minimise the effect on the environment. The company is looking to become as automated as possible to reduce human error, but due to financial concerns, everything is to be done as economically as possible or done over a longer period of time to decrease financial burdens .

As the environment has always been of importance to management it was decided to develop and implement an integrated management system including aspects relating to quality and occupational health and safety, but the main focus would remain towards the environment.

Emphasis will be placed on process innovation and improvement, management system implementation as well as economics and cost saving throughout this study.

The specific objectives of this thesis are the:

- evaluation of the company and its' current status,
- evaluation of the different management systems to be implemented,
- integration of the three management systems,
- integration of the three management systems in order to reduce duplication, and
- long term plan for implementation

Figure 1-1 shows the thought process behind the implementation of the integrated management system (IMS).

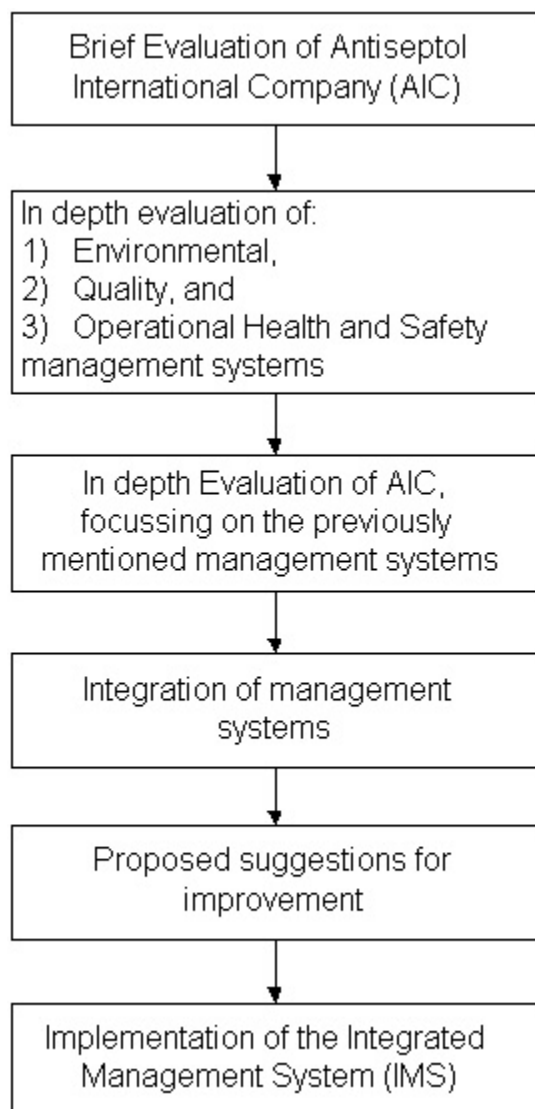


Figure 1-1: The mind map of the process to be followed for implementation of the IMS

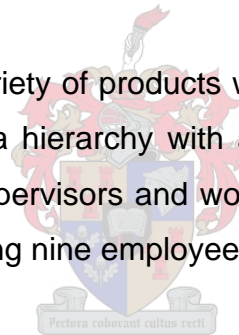
## 2. Antiseptol International Company (Pty) Ltd

In order to get a better understanding of the organisation and how it operates, this chapter will give a brief background of the organisation, its location and layout as well as a brief description of how the organisation operates.

### 2.1 Company Background

Antiseptol International Company (AIC) is mostly a manufacturer of hair products, which are sold to wholesalers. Often the products are made according to these wholesalers' specifications. Currently these wholesale companies are limited to those supplying hair products to salons, the retail market has not been considered as of yet.

The company makes a wide variety of products with a total quantity of 50 kilolitres per month. The company has a hierarchy with a very flat structure consisting of the: CEO, top management, supervisors and workers. Of the 53 employees there are 44 workers with the remaining nine employees being supervisors, management and the CEO.



The suppliers of the inventory items consist of both large and small organisations, therefore some of the suppliers do have management systems in place while others don't.

The company has been in existence since 1956 and is currently in its growth stage as in the last five years it has built, and moved, to new premises including an office block and factory building with the construction of another building to commence next year. Employees have increased in number by 40% in the last five years from 38 to 53.

## 2.2 Location and Layout

AIC is located in the industrial area of Spartan Ext. 3 on the East Rand of Johannesburg, Gauteng, RSA and falls within the Ekurhuleni municipal district.

The company is situated close to the R24 freeway which provides good infrastructure and fast transport of products. Spartan Ext. 3 is part of the large industrial areas of Spartan and Isando which have a high concentration of suppliers of raw materials and packaging material which the company uses for fast and cheap delivery, many maintenance organisations and transport services are also present for fast service.

The factory has approximately 2400m<sup>2</sup> of floor space (including both upper and lower level) and is built on a 4550 m<sup>2</sup> property, laid out as shown in Figure 2-1. A layout of the factory floors (ground level and upper level) are shown in Figure 2-2 and Figure 2-3 respectively.





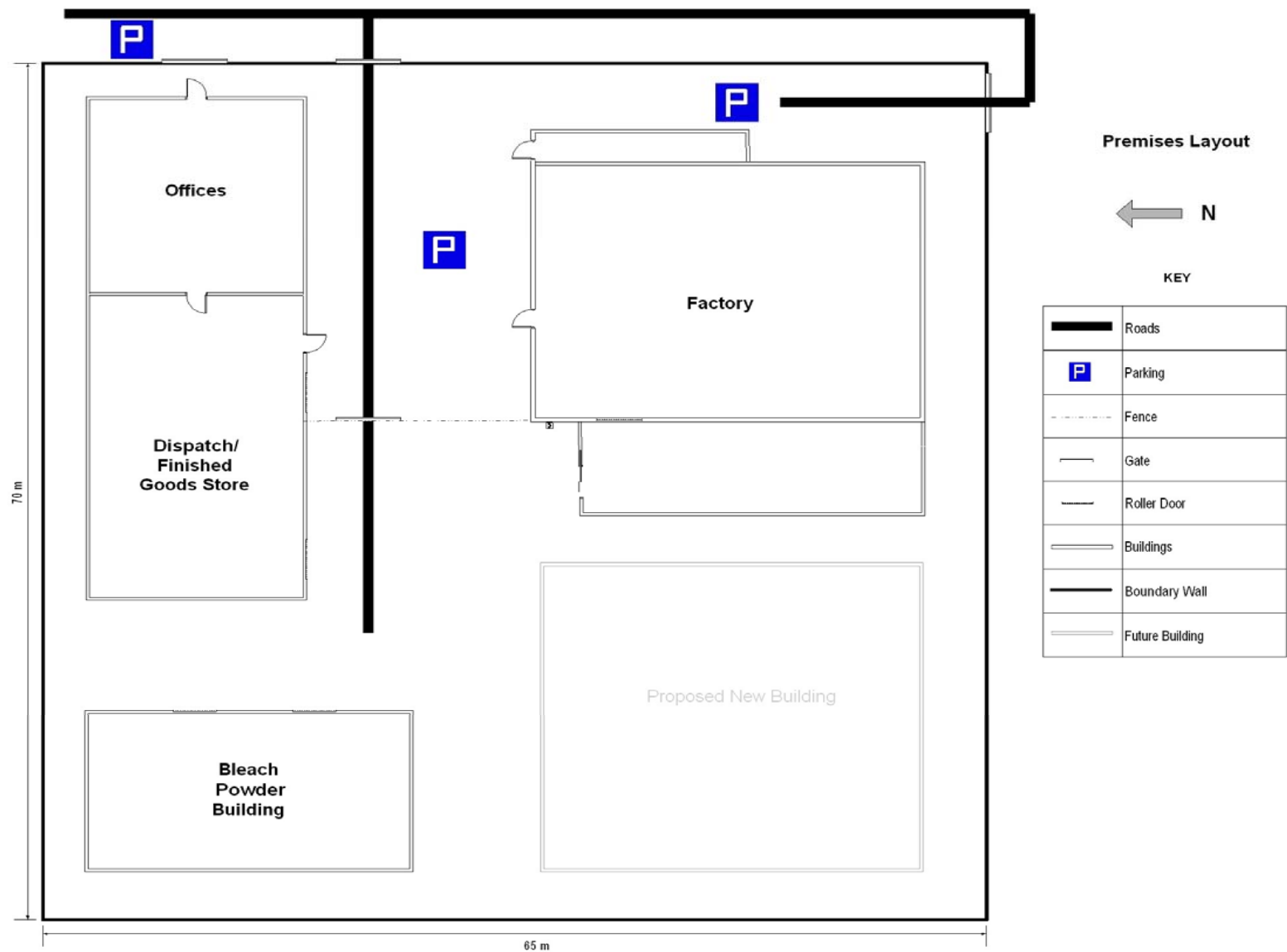


Figure 2-1: Layout of premises





## 2.3 Operation

AIC operates only during the day from 7:45 to 16:45 (Fridays 8:00 to 14:00) and Monday to Friday

Raw materials and empties come in and are put onto the computer according to the delivery note and then put in the chemical store, alcohol store or in the case of drums, in the raw material drum storage areas and the empties store respectively. There is already an inventory control system in place but it is only there to check if there are enough raw materials to make a certain product

Once an order is received from the customer it is fed into the computer and a manufacturing order is issued for a product to be produced.

The manufacture order is sent to the chemical store where the store man issues the raw materials, after weighing them into smaller vessels and records this issue on his stock card.

The employee producing the product fetches the raw materials from the chemical store and then through experience, produces the required product. Most of the products are simply a mixture of raw materials, therefore the only unit operations are mixing tanks (plastic and stainless steel) along with stirrers, pumps and heaters. Most of the production takes place in the main factory (see Figure 2-2), with the exception of the bleach powder because this is very dusty. Products including gels, gelwaxes, conditioners, treatments, relaxers, silicons, etc. are produced in the general production area. Shampoo, peroxide, perm lotion and alcohol based products (lacquers and hairsprays) are produced in their own respective rooms/areas

The product is then tested and adjustments made. These adjustments are made by the production manager out of her head (as she is the only one who knows what to use for adjustments, quantities to be used are not known) according to a trial-and-

error method of performing the adjustment in small increments and re-testing the product numerous amounts of times until it is correct.

Once the product is within specifications it is either filled straight from the tank or first filled in to smaller vessels and then either kept in the bulk store area for future filling or sent for filling and packaging.

A fill order is issued by the production manager and the empties store issues the appropriate empty vessels and labels. The filling machines, cappers, labelling machines, etc are set up by the filling area supervisors and the product is filled and packaged into bottles, jars and/or tubes.

Once packaged the finished goods are sent to the finished goods store from which they are either collected or delivered.

From this it can be seen that the production process can be broken down into 4 main sections:

1. Raw material storage,
2. Product manufacture,
3. Filling/Bottling,
4. Final product storage.



Some digital photos of these sections can be found in Appendix A to help give a clearer picture.

## **2.4 Integrated Management System**

Due to worldwide trends for better quality and environmental awareness, the company is looking to implement an environmental management system to become ISO 14000 certified and a quality management system to become ISO 9000 certified. The following is to be done:

- Improve product marketing as the customers (especially the larger international customers) are under great pressure from the public to show that they are environmentally friendly and still offer a high quality product.
- Minimise long term costs. Although there would be fairly large initial costs, paying to release less waste will pay off fairly quickly as the penalty on waste disposal increases greatly with time. Other cost benefits will also be seen with time such as fewer product returns due to bad quality etc.
- Ensure the future development of the company. If the company is to grow and market its' own label, it would be very useful if not obligatory to be ISO certified.
- Help give the company an edge in the highly competitive market.

The requirements of the Operational Health and Safety (OH&S) Act (Act 85 of 1993) are also going to be considered (and integrated along with the other two systems). Some of the OH&S measures are already in place but there are many procedures and other elements which are lacking.

In order to implement the quality and environmental control systems, the manufacturing process is first going to be investigated, checking where it can be changed or improved to maximise quality and minimise waste. Only after this is done, is a waste treatment plant going to be considered.

## **2.5 Chapter Summary**

In this chapter a background is been provided, the location and layout described and how the company operates is described, one has a clearer picture of the organisation. From here the much needed management systems can be considered.

### 3. Management and General Systems

The main focus of this thesis is the environment, for that reason, the Environmental Management System (EMS) is going to be the backbone of the Integrated Management System (IMS). In the following chapter

- EMSs' are going to be investigated with specific focus on the ISO 14000 EMS. Various other Environmental Management programs, which a company can use as stand-alone systems or incorporate into the EMS, are also looked into.
- QMSs are going to be discussed. As with the EMS being implemented the ISO 9000 system for quality is to be implemented. The basic principles of the ISO 9000 system are looked at and discussed.
- The Operational Health and Safety (OH&S) Act is going to be discussed as this is not only a good guideline but compliance is required by law.

#### 3.1 Why implement a management system?

There are numerous benefits of implementing a management system for the company, some of which include (ESA Consulting, 2004):

- Gives a clear signal to the outside world of an organisation's commitment to quality and the environment,
- Improving customer and public image,
- As a response from a client,
- Meet customer requirements,
- Enhanced customer trust,
- Pressure from stakeholders and customers,
- Legislative requirements,
- Competitive advantage,
- Increased marketing opportunities,
- Financial benefits,
- Reduced costs,

- Better credit terms,
- Improved customer satisfaction,
- Fewer mistakes, defects and accidents,
- Employee involvement,
- Team working and staff morale are improved,
- Establish the foundation upon which Total Quality may be achieved,
- Raised awareness of environmental issues,
- Improved environmental performance,
- Improved compliance,

## **3.2 Environmental Management Systems**

### **3.2.1 Environmental Management Systems in General**

Organisations in all spheres of business are increasingly concerned in achieving and demonstrating sound environmental performance by controlling the impact of their activities, products and services on the environment. International standards covering environmental management are intended to provide organisations with the elements of an effective environmental management system which can be integrated with other management systems and requirements to help organisations to achieve environmental and economic goals. (SABS, ISO 14001, 1996)

An Environmental Management System (EMS) is a method of incorporating environmental care throughout the corporate structure. An EMS is a problem-identification and problem-solving tool, based on the concept of continual improvement that can be implemented in an organisation in many different ways, depending on the sector of activity and the needs perceived by management. (UNEP, 2000)

Most environmental standards are much the same in their aims and requirements. The overall aim being environmental protection and pollution prevention, while



being balanced with socio-economic needs. The basic structure of an EMS is shown in Figure 3-1.

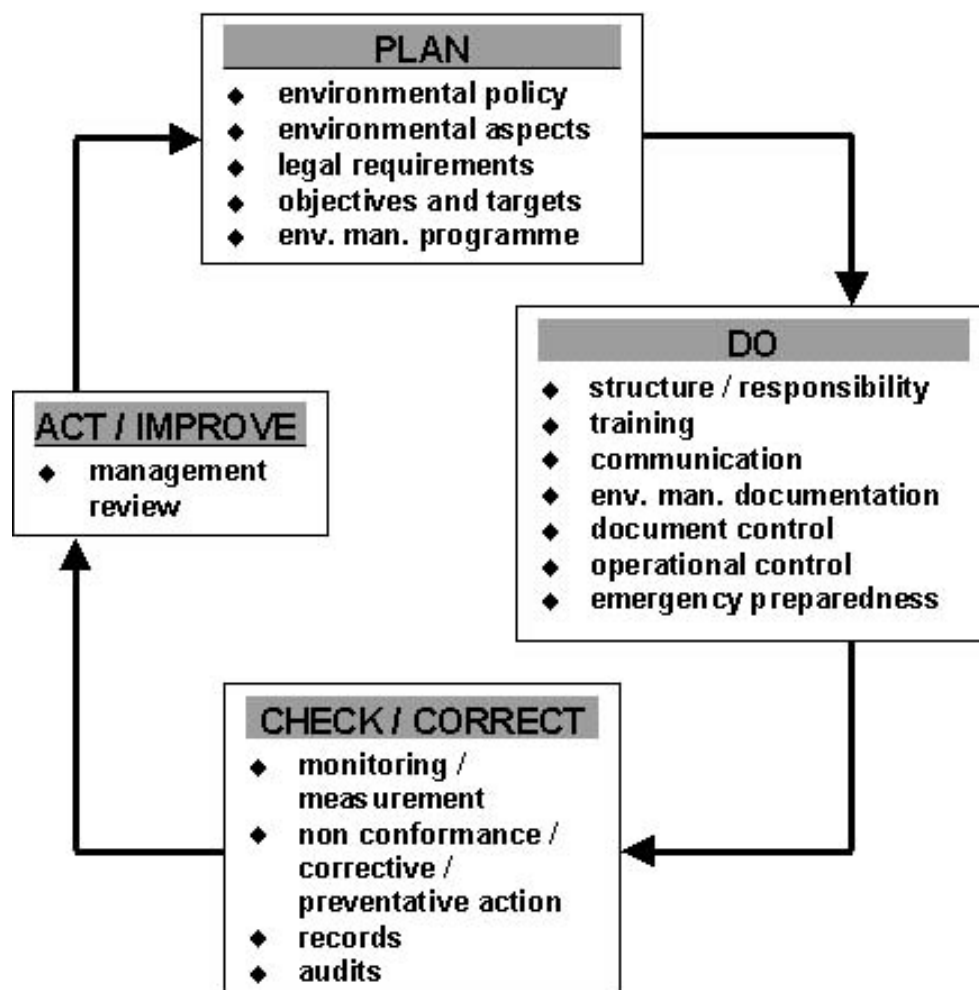


Figure 3-1: Key elements of an EMS. (UNEP, 2000)

Implementing any of the previously mentioned environmental management systems correctly results in a win-win situation for the company. An effective EMS means that the environment wins, the community wins and the company wins. There are numerous benefits for the company as discussed in section 3.1:

There are also many implementation manuals/guidelines (both hard copies and online) to help and guide implementing an EMS such as:

- Stapleton PJ, Glover MA, Davis SP (2001) Environmental Management Systems: An Implementation Guide for Small and Medium-Sized Organizations, Second Edition, NSF International
- Gmur, NF (2003) NSLS Environmental Management System Manual, Revision 8. <http://nslsweb.nsls.bnl.gov/nsls/manuals/EMS/EMSmanual.htm>

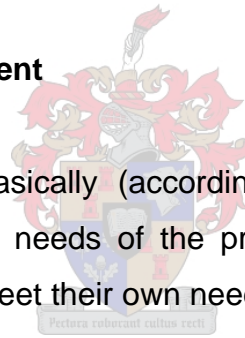
And many others.

### **3.2.2 Environmental Management Programs**

As part of an environmental management system, techniques or environmental management programs such as sustainable development, pollution prevention, cleaner production, eco-efficiency and life cycle assessment can also be implemented as these help achieve objectives and targets.

#### **3.2.2.1 Sustainable development**

Sustainable development is basically (according to the Bruntland definition) 'Development which meets the needs of the present without compromising the ability of future generations to meet their own needs'.



Although sustainable development may seem the same as environmental management it is a slightly different concept. Environmental management is often referred to as the business answer to the challenge of sustainable development (ANEC, 2003).

Although both aim for a clean and unpolluted environment, the protection of natural resources as well as environmental training and awareness, there are differences (Bezuidenhout, 2003):

- Environmental management is audited for compliance while sustainable development goes beyond compliance.

- The main objective of environmental management is to reduce adverse impacts on the environment which do not allow future generations to inherit the same amount of natural, social and economic wealth.
- Environmental management focuses on environmental impacts whereas sustainable development investigates the relationships between environmental, social and economic benefits.

### **3.2.2.2 Pollution Prevention and Cleaner Production**

Cleaner Production, which is also called pollution prevention in North America, is the international term for reducing environmental impacts from processes, products and services by using better management strategies, methods and tools (Cleaner Production, 2004).

Through various methods such as those listed below, a cleaner production program makes the working environment safer for all employees and normally large cost savings are found.

Some common cleaner production techniques which can be utilised include (Bezuidenhout, 2003):

- Improved operating procedures,
- Preventative maintenance,
- Waste stream segregation,
- Raw material replacement,
- Product redesign,
- Equipment modification,
- Process alteration,
- Wastewater reduction,
- In-process recycling/reuse, and
- On-site recycling.

### **3.2.2.3 Eco-efficiency**

Eco-efficiency means producing goods and services with less energy and fewer raw materials, resulting in less waste, less pollution and lower costs.

The following is a list of actions to help implement eco-efficiency (Bezuidenhout, 2003):

- reduce the raw material intensity of goods and services,
- reduce the energy intensity of goods and services,
- reduce toxic emissions,
- enhance material recycle-ability,
- maximize the use of renewable and recycled resources,
- extend product durability,
- Increase the service intensity of goods and services.

### **3.2.2.4 Life Cycle Assessment**

Life cycle assessment is a tool for evaluating the total environmental impacts associated with a product throughout its life cycle, from the extraction of raw materials through to disposal. By doing a life cycle assessment the environmental impacts and thus, the aspects of a product can be better understood and thus improvements can be done more effectively.

### **3.2.3 ISO 14000**

There is a wide variety of international environmental organisations that have developed standards including: The International Organisation for Standardisation (ISO 14000), The European Commission (Eco-Management and Audit Scheme or EMAS), British Standards (BS 7750), etc.

The International Organisation for Standardisation's Environmental Management System Standard, ISO 14000, is the most widely recognized standard for environmental management systems in the world. (Canadian Sustainable Forestry Certification Coalition, 2004). Due to this, and that ISO 14000 is also approved by SABS and internationally recognised, it will be the environmental management system which is considered in the rest of this section.

The ISO 14000 series of standards is comprised of a compliance standard ie. ISO 14001 (Environmental Management Systems) and several guideline standards. The ISO 14000 series is modelled after the BS 7750 (Environmental Management Systems) standard, originally published in 1992 and updated in 1994. (MGMT Alliances Inc., 1995)

The ISO 14000 program is designed around the key elements of an EMS (Figure 3-1) and these are now going to be discussed.

### **3.2.3.1 Planning**

The following elements of the environmental system are developed and scheduled before implementation.

#### **3.2.3.1.1 Environmental Policy**

An environmental policy is top management's declaration of its commitment to the environment. This policy should serve as the foundation for an EMS and provide a unifying vision of environmental concern by the entire organisation. It provides a framework for actions and for setting the environmental objectives and targets.

The policy should relate to the products and services, as well as supporting activities and should reflect three key commitments, ie.

- Continual improvement,
- Pollution prevention,
- Compliance with relevant laws and regulations.

Through the environmental policy the organisation is to communicate these commitments to customers, suppliers, employees and interested parties. For this reason the environmental policy must be documented, communicated to the above groups and be made publicly available.

#### **3.2.3.1.2 *Environmental aspects***

Environmental impacts are the changes, both positive or negative, in the environment that arises from an organisation's activities, products or services. An organisation's environmental impacts are considered in order to eliminate the negative ones and maintain the positive ones. Knowing what the impacts are, is only part of the challenge, where they come from is just as important.

Aspects are activities and products that have or can have a significant impact on the environment. These are identified, assessed and listed in the environmental aspect register, along with their impact, and are used as inputs for setting objectives and targets.

#### **3.2.3.1.3 *Legal and other requirements***

All internal and external legal requirements (National, Provincial, Municipal and any other) pertaining to the EMS of the specific company are identified and regularly reviewed. These serve as additional inputs for setting objectives and targets.

Because the national legislation is quite comprehensive in respect of the environment and has to be complied with, some of the more important legislation pertaining to the environment, which is relevant to the company focussed on, is mentioned in Appendix B.

#### **3.2.3.1.4 Objectives and targets**

The objectives which stem from the environmental policy are broken down into more detailed environmental management objectives, based on the contents of the environmental aspect register, legislation, interested and affected parties and financial constraints. Targets which arise from these objectives, are set and should be quantified and have a completion date set.

#### **3.2.3.1.5 Environmental management programs**

Programs to achieve environmental targets are launched and managed through the appropriate forums in the various functional areas to achieve the set objectives and targets. These can include the programs discussed above (3.2.2 Environmental Management Programs) but will vary from one organisation to another.

#### **3.2.3.2 Implementation and Operation**

The following elements apply to the implementation and operational phases of the EMS:

##### **3.2.3.2.1 Structure and responsibility**

The Environmental Management Representative (EMR) is responsible for the overall effectiveness and efficiency of the EMS and for its' implementation.

All roles, responsibilities and authorities related to the EMS are delegated and described in the various applicable procedures including the appropriate job descriptions.


##### **3.2.3.2.2 Training, awareness and competence**

Managers are responsible for ensuring that training programs which provide for awareness and competency of all personnel with regards to:

- The importance of the environmental policy and EMS;
- Significant environmental impacts of their work activities and the environmental benefits of improved personal performance;
- Their roles and responsibilities in achieving conformance with the requirements of the EMS;
- The potential consequences of departure from specified operating procedures.

Employees are also to be educated in other areas (eg. general environmental concerns) in order to build up an employee body that is aware of and concerned about the environment and who have the knowledge and skills to work in such a way as to solve current problems and prevent new ones.

#### **3.2.3.2.3 Communication**

- 
- (a) Formal internal communication regarding environmental aspects takes place through the appropriate forums.
  - (b) External communication with local authorities, customers and other interested parties is handled by the EMR.

#### **3.2.3.2.4 Environmental management system documentation**

The Environmental Management Manual is the top-level EMS procedures, from which all other EMS documents evolve. Other documents interfacing with the EMS and forming part of the documentation system are referred to in the various EMS procedures.

#### **3.2.3.2.5 Document control**



Documents are to be controlled to ensure correct and up-to-date procedures, instructions and other documents. Responsibility and authority for preparing documents, making changes to them and keeping them up-to-date is to be designated

#### ***3.2.3.2.6 Operational control***

Operations and activities associated with the environmental aspects listed in the Environmental Aspect Register (see 3.2.3.1.2 Environmental aspects above) are:

- Documented and controlled where necessary to ensure conformance to the EMS requirements;
- Made visible to suppliers and contractors where applicable to ensure that these are documented and controlled by them to ensure conformance to EMS requirements.

#### ***3.2.3.2.7 Emergency preparedness and response***

Environmental impacts associated with potential or actual incident and emergency situations are to be prevented or mitigated. A properly and adequately trained emergency team is to be chosen and an up-to-date emergency procedure is to be implemented and maintained.

#### **3.2.3.3 Checking and Corrective Action**

The effective operation of the environmental system is maintained through the following measures:

##### ***3.2.3.3.1 Monitoring and measurement***

Companies legally have to measure and document the release of any substance into the environment (xxx - Reference). The key characteristics of operations and activities listed in the aspect register are monitored and measured according to the requirements of the relevant procedures.

#### **3.2.3.3.2 *Non-conformance and corrective and preventive action***

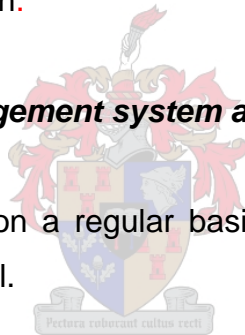
Environmental non-conformances are handled and investigated and corrective action is implemented in order to prevent it from happening again. Preventive action is better than corrective action because it could prevent a non-conformance from happening all together.

#### **3.2.3.3.3 *Records***

Records of activities are maintained to demonstrate conformance to the requirements of the management systems. Records of past environmental performance are used for benchmarking performance, design of treatment facilities and are essential for any decision.

#### **3.2.3.3.4 *Environmental management system audit***

The EMS is internally audited on a regular basis to ensure conformance to the requirements of the EMS manual.



#### **3.2.3.4 *Improvement***

This is a vital aspect as continual improvement is one of the major aims of an EMS

##### **3.2.3.4.1 *Management Review***

The environmental management system is regularly reviewed by the management team to ensure its continuing suitability, adequacy and effectiveness.

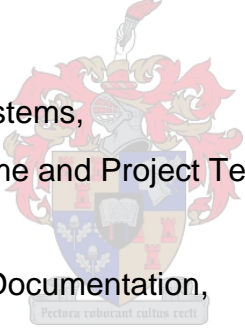
### **3.3 Quality Management Systems**

### 3.3.1 Quality Management Systems in general

Increased global competition has led to increasingly more stringent customer expectations with regard to quality. To be competitive and to maintain good economic performance, product suppliers need to employ more effective and efficient systems.

Customers look at two main aspects when buying a product: price and quality. As the prices of a large organisation often cannot be challenged, the quality of products of small organisations has to be at least equal, often higher than their larger counterparts.

The basic steps to achieving and maintaining a Quality Management System are as follows:

- 
- Evaluation of Existing Systems,
  - Develop Action Programme and Project Terms of Reference,
  - System Design,
  - Prepare Quality System Documentation,
  - Application for Assessment,
  - Implementation,
  - Internal Audits (ongoing),
  - Management Review (ongoing),
  - Pre-assessment Audit,
  - External Assessment, by third party,
  - Registration,
  - Ongoing internal audit and improvement of the installed systems.

### 3.3.2 ISO 9000

There is a wide variety of international quality organisations that have developed standards incl: The International Organisation for Standardisation (ISO 9000), European Union Standard (EN 29000), British Standards (BS 5750), etc. ISO 9000 is now recognised as replacing the earlier BS 5750 Quality Standards.

ISO 9000 is the most common quality management system and is used worldwide, for this reason and because the ISO 14000 system is to be used for the EMS, the ISO 9000 system is going to be focussed on throughout the remainder of this chapter and thesis.

ISO 9000 is a Quality Management System which provides a basis to consistently manufacture to required specification. Being ISO 9000 compliant does not indicate that every product meets the customers' requirements, only that the quality system in use is capable of meeting them. (Peach et al., 2003)

The ISO 9000:2000 series of standards is comprised of, four core standards, a requirements standard nl. ISO 9001 and three guideline standards nl: ISO 9000, ISO 9004 and ISO 19011.



### 3.3.2.1 ISO 9000 principles

ISO 9000:2000 is based on eight quality management principles which are used by top management as a framework towards improved performance and are (ISO, 2004):

1. **Customer focus:** Organizations depend on their customers and therefore, should understand current and future customer needs, should meet customer requirements and strive to exceed customer expectations.
2. **Leadership:** Leaders establish unity of purpose and direction of the organization. They should create and maintain the internal environment

in which people can become fully involved in achieving the organization's objectives.

3. **Involvement of People:** People at all levels are the essence of an organization and their full involvement enables their abilities to be used for the organization's benefit.
4. **Process approach:** A desired result is achieved more efficiently when activities and related resources are managed as a process.
5. **System Approach to Management:** Identifying, understanding and managing interrelated processes as a system contributes to the organization's effectiveness and efficiency in achieving its objectives.
6. **Continual Improvement:** Continual improvement of the organization's overall performance should be a permanent objective of the organization.
7. **Factual Approach to Decision Making:** Effective decisions are based on the analysis of data and information
8. **Mutually beneficial supplier relationships:** An organization and its suppliers are interdependent and a mutually beneficial relationship enhances the ability of both to create value

There are many different ways of applying these quality management principles. The nature of the organisation and the specific challenges it faces will determine how to implement them. Many organisations will find it beneficial to set up quality management systems based on these principles.

Three basic requirements of the ISO 9001 standard are:

1. Document the processes that affect quality
2. Retain documentation and data that describe the quality of the product
3. Ensure that your processes produce consistent quality

Figure 3-2 helps understand the sequencing and activities that will be involved.

## ISO 9001 Process Flowchart

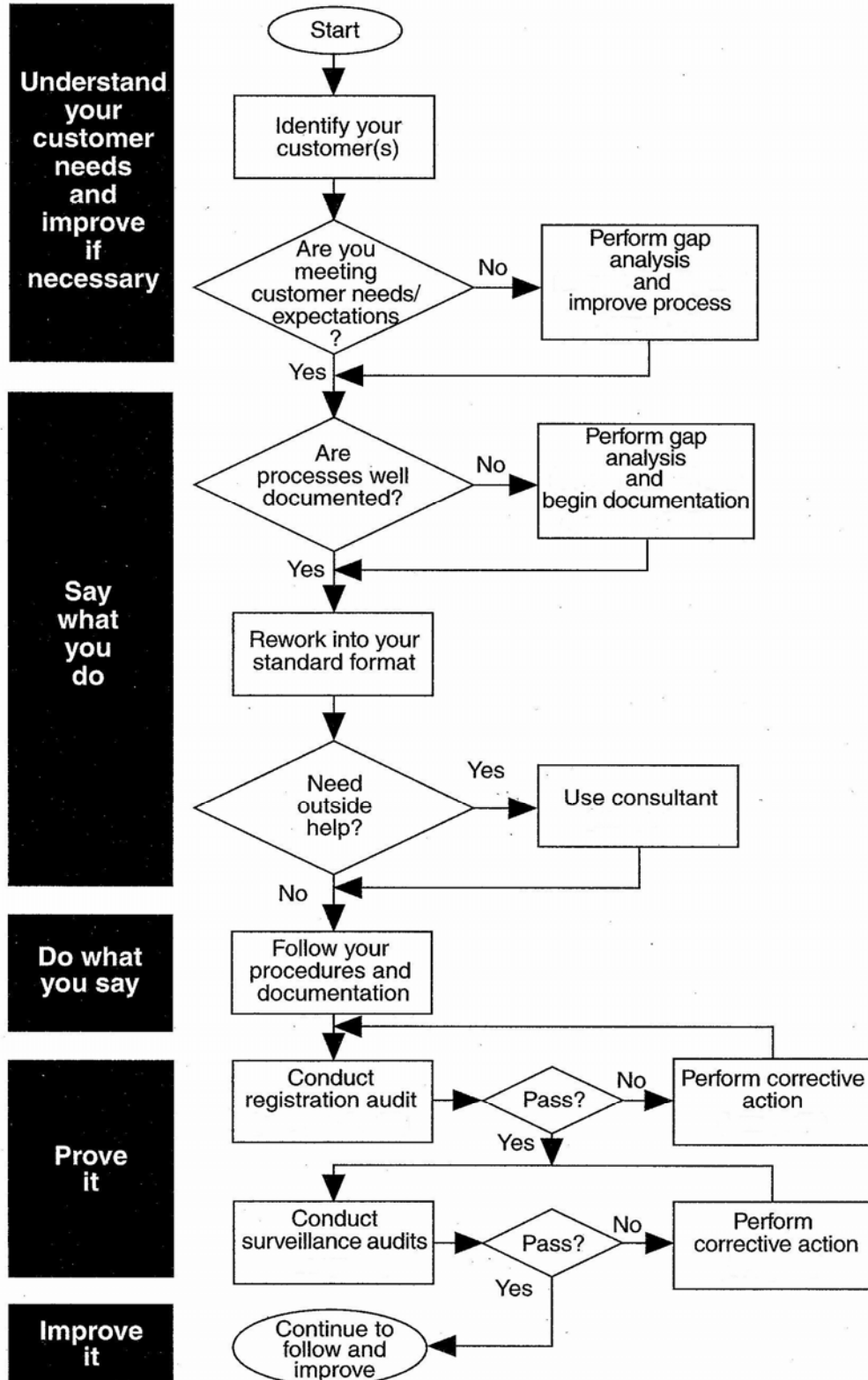


Figure 3-2: ISO 9001 Process Flowchart (Peach et al, 2003)

ISO 9001 requires that all applicable requirement of the standard are met and that all procedures are adequately documented. For this reason a gap analysis is to be performed in order to identify any missing process elements or information.

Just as ISO 14000 has key elements around which it is based, Figure 3-3 shows ISO 9000's key elements or 'process model' which forms the basis of ISO 9000 which is going to be discussed in the remainder of the chapter.



## ISO 9001:2000 Process Model for Quality Management

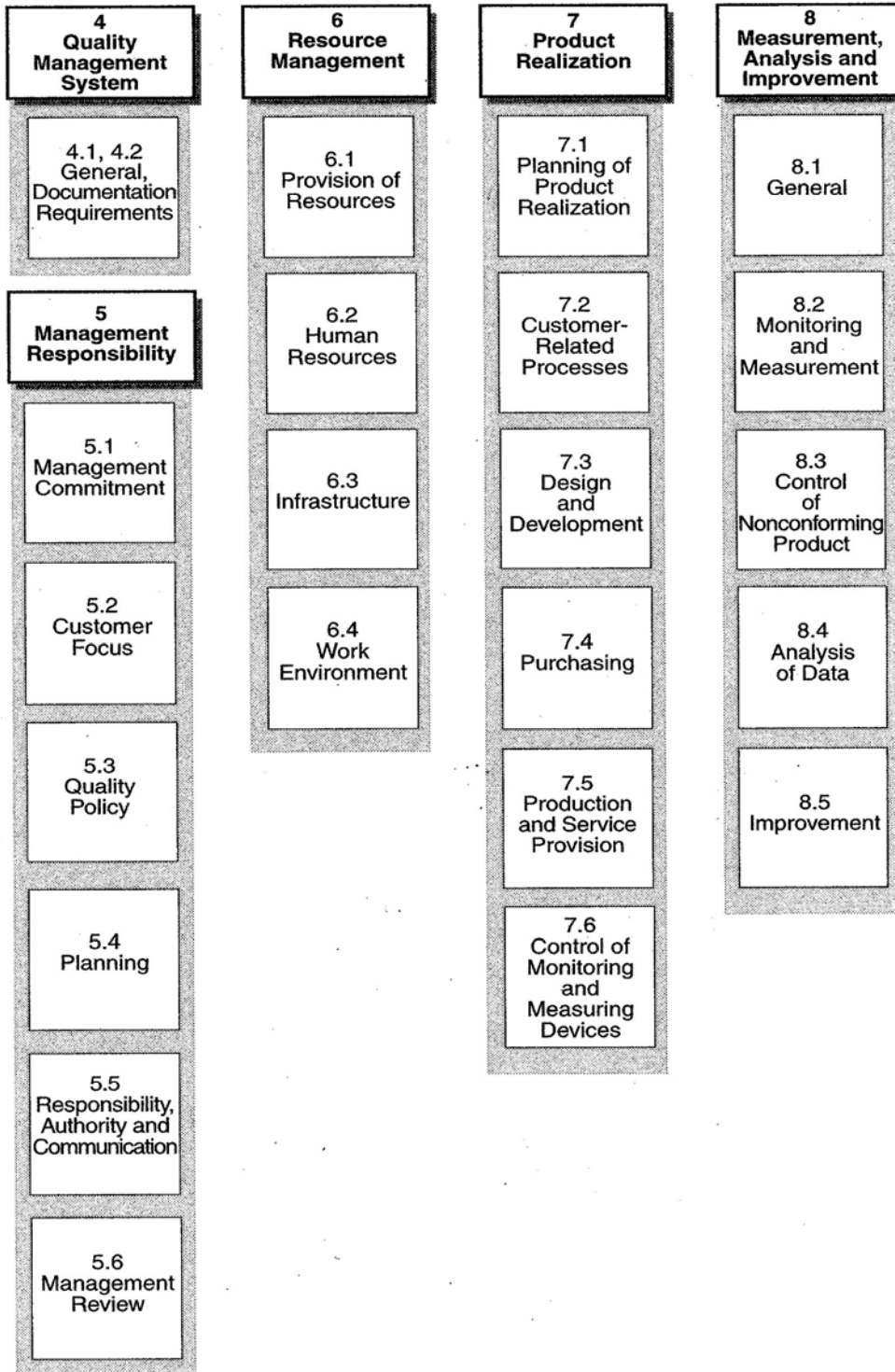


Figure 3-3: ISO 9001 Process Model for Quality Management (Peach et al, 2003)



### 3.3.3 ISO 9000 Process Model

#### 3.3.3.1 General Requirements

This is the means of demonstrating that a QMS is in place, is effective and is continually improving.

#### 3.3.3.2 Documentation Requirements

Documentation requirements ensure that all documentation is well structured so that the QMS operates as effectively as possible and so that the correct information is captured.

The documentation can be identified in four levels, from top management moving down the organisational ladder:

##### Level 1: Quality Manual

Top managements statement of the organisations quality policy.

##### Level 2: Procedures

Defines activities at the departmental level. It defines the who, when and what aspects

##### Level 3: Work\Job Descriptions

Describes how jobs are accomplished, compiled by operators and trainers. It defines the how aspect.

##### Level 4: Other Documentation

Recording of forms, process sheets, test & inspection sheets, tags and labels that become a quality record, usually done by middle management.



### **3.3.3.3 Management Responsibility**

#### **3.3.3.3.1 Management Commitment**

This is done via establishing the quality policy and quality objectives, conducting management reviews and providing resources.

This is done to ensure that top management takes a leading and visible role in the major implementation, administration and decisions to do with the QMS.

#### **3.3.3.3.2 Customer Focus**

This is done by defining customer and regulatory need which are later translated into requirements.

This is done to ensure that all customer and regulatory needs are being met.

#### **3.3.3.3.3 Quality Policy**

Responsibility should be assigned to an individual or team (with input from across the entire organisation) to develop the quality policy which should include:

- The organisation's quality objectives,
- Management's commitment to meeting requirements,
- Continual improvement,
- Relevance to organisational goals,
- Expectations and needs of customers.

The policy is to be communicated and understood by everyone in the organisation.

The quality policy is compiled to show management's commitment and to give a guideline as to what is expected of the QMS.

#### **3.3.3.3.4 Planning**

Measurable quality objectives are to be established throughout the organisation with plans on how to meet these objectives.

This is done in order to keep focus on what is to be done and how. If it weren't for this planning, only certain sections of the organisation would be focussed on and other sections would be overlooked and neglected.

#### **3.3.3.3.5 Responsibility, Authority and Communication**

A vital key to the proper implementation and management of a QMS:

- **Responsibility and Authority:** Organograms and job descriptions are necessary as is the appointment of a quality management representative (QMR) who ensures that the QMS is properly established and implemented.
- **Internal Communication:** The provisions and effectiveness of the QMS is to be communicated to all levels and functions within an organisation.

This is done to demonstrate that the QMS is well administered.

#### **3.3.3.3.6 Management Review**

At the management review, amongst others, the effectiveness of the QMS is looked at, the current performance is reviewed and improvement opportunities are looked for.

This is done to ensure effective and efficient running of the QMS as well as continual improvement.

### **3.3.3.4 Resource Management**

#### ***3.3.3.4.1 Provision for Resources***

Resource requirements are to be identified, allocated and provided.

This is done so that resources are provided where needed timely and without any surprise.

#### ***3.3.3.4.2 Human Resources***

Training needs are to be identified and provided eg: Process knowledge, product knowledge etc. A training manual is to be compiled to document this training. Personnel qualification and training is to be filed in individual personnel files including previous experience, medical records, awards, promotions, etc.

This is to be done in order to keep training comparable and to know what training and qualifications employees have.

#### ***3.3.3.4.3 Infrastructure and Work Environment***

All necessary physical resources are to be defined eg. equipment, facilities, transportation, etc.

This is done so that:

- It is known what physical resources are to be purchased or are already purchased,
- It is known what employees are needed to properly use these physical resources, and
- Physical resources which have an effect on quality are to be monitored and measured.

### **3.3.3.5 Product Realisation**

#### ***3.3.3.5.1 Planning of Product Realisation***

Means by which a quality product is to be produced are planned.

This is done in order to be certain that there are plans for all realisation processes to be carried out under controlled conditions as this ensures that quality objectives are met.

#### ***3.3.3.5.2 Customer-Related Processes***

This is done, amongst others, by documenting the customers' requirements (always updated through customer interaction), establishing order/contract procedures and verifying the capability to meet the requirements.

This is done to ensure that the organisation will be able to meet the customers' needs even before taking the order.

#### ***3.3.3.5.3 Design and Development***

These are the procedures set to control, verify and validate product design and supporting software.

This is done by making use of some of the previous sections discussed to document customer, regulatory and other requirements (input), assign staff and provide resources.

The next step is to document the control procedures, with milestones which are required by the standard. Outputs are to be designed to satisfy the inputs. Outputs are to be verified, validated and finally improved.

#### **3.3.3.5.4 Purchasing**

Existing purchasing specifications are to be reviewed and upgraded. Criteria for determining supplier acceptability and classification are to be established. Purchasing documents are to be compiled and all records kept.

This is done in order to make certain that products (raw materials, hardware, software, services, etc.) received from suppliers meets the organisations requirements as these are going to be used directly or indirectly in producing the final product. This helps to keep a constant output quality.

#### **3.3.3.5.5 Production and Service Provision**

This consists of five divisions:

- **Control of Production and Service Provision:** This is to make certain that processes are carried out under controlled conditions
- **Validation of Processes for Production and Service Provision:** In situations where it may not be possible to verify quality after the process, the process itself has to be validated.
- **Identification and Traceability:** This is done to make certain that the product is properly identified at all stages of production and to avoid errors causing waste and loss. Traceability also includes where products are delivered/supplied, in the event of a product recall.
- **Customer Property:** Procedures for verification, storage and maintenance of customer supplied property have to be in place in order to make certain that the property received from the customer will be incorporated into the product and is of a satisfactory quality.
- **Preservation of Product:** This is done to protect the integrity of the product and to make certain that the procedures for identification, handling, storage, preservation, delivery, etc. of the product are adequate.

### **3.3.3.5.6 Control of Monitoring and Measurement Devices**

The control of monitoring and measurement devices is done by identifying all inspection and test requirements, listing equipment to conduct these inspections and tests, identifying calibration requirements and verification procedures for each piece of equipment, reviewing existing procedures and implementing the procedures.

This process is to ensure that inspection, measuring and testing equipment is properly calibrated and will remain so. This is done to ensure that equipment is capable of consistently providing specified measurement requirements so that proper decisions can be made for control and acceptance of product.

### **3.3.3.6 Measurement, Analysis and Improvement**

#### **3.3.3.6.1 General**

This is the demonstration that a plan for measuring, analysing and continually improving procedures and products exists and is in operation.

This is to make certain that monitoring and measurement activities needed to ensure conformity and improvement are defined, planned and implemented.

This method of defining, planning and implementing these elements make up the remainder of this section.

#### **3.3.3.6.2 Monitoring and Measurement**

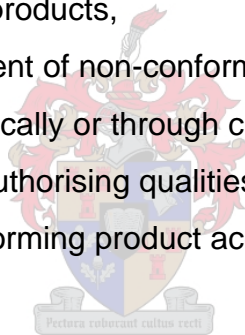
- **Customer Satisfaction:** This is an activity plan to determine and put into practice the information that reflects the satisfaction being experienced by the customer.

- **Internal Audit:** A plan and procedure for conducting internal audits of the QMS.
- **Monitoring and Measurement of Processes:** This is the demonstration that process-monitoring and process-control procedures are in operation to ensure that the product meets its quality targets.
- **Monitoring and Measurement of Product:** This is the demonstration that inspection and test procedures are in operation to ensure that the product conforms to specification including incoming, in-process and finished products.

#### ***3.3.3.6.3 Control of Non-conforming Product***

Procedures that will help to:

- Identify non-conforming products,
- Evaluate degree and extent of non-conformance,
- Segregate product (physically or through clear identification),
- Define responsibility of authorising qualities,
- Use/dispose of non-conforming product according to procedures, and
- Notify certain parties.



This is to make certain that one does not use or dispatch non-conforming product.

#### ***3.3.3.6.4 Analysis of Data***

This is the process for identifying the need for collecting data required for establishing, controlling and verifying process capability and product quality, once established, the procedures for data collection and analysis are to be maintained and documented.

This is to make certain that the QMS is effective and to identify places in the process where the collection and analysis of data is necessary.



### **3.3.3.6.5 Improvement**

This is the constant search for ways to improve the QMS. It is also the procedures in use to prevent the occurrence of non-conformances.

This is done to make certain that there is a plan for continual improvement of the QMS and a minimisation of non-conformances.

## **3.4 The Occupational Health and Safety Act**

### **3.4.1 Introduction**

The health and safety of employees is a major issue in the modern organisation. With major incidents occurring worldwide due to poor management, poor design, poor housekeeping or simply due to an accident, which often could have been prevented, governments and citizens all over the world are scared for their safety and are receiving more and more power. Power to be heard, to be taken seriously and to get what they deserve – a safe workplace and living environment to live in.



With more and more power shifting towards the employee, it has become increasingly important for an employer to not only comply with the act, but to surpass simple compliance.

Anything to do with the well-being of any person who is or may be affected by the organisation's activities is of vital importance to the organisation and care has to be taken to prevent any negative effects on any such person. The OH&S Act focuses on preventing such negative effects (Benjamin and Thompson, 2000)

### 3.4.2 The Act

The OH&S Act is a South African law passed by government to try and make a safer working environment for everybody concerned, it has to be complied with by every employer or self-employed person. The act can be seen as adding to the rights of each person to fair labour practices and to an environment which is not detrimental to their health.

The Act requires employees to act in a manner that is conducive to safety and failure to comply is a criminal offence.

The Act requires the identification of hazards and an assessment of the extent to which they constitute a risk. The assessment will determine what precautionary measures must be taken to create a safe and risk-free working place.

Danger – Anything that may cause injury or damage to persons or property

Hazard – Any source of or exposure to danger

Risk – Probability that injury or damage will occur

The OH&S act is to be complied with very closely for two main reasons:

- The safety of employees, customers, visitors and any other person who may be directly affected by the organisation's activities.
- If the statutory standards and regulations are not complied with, the employer(s) will be penalised.

The law has, in previous years, been predominantly used to determine blame for accidents and ascertain who should bear the cost. The duties in OH&S Act are designed to prevent the occurrence of accidents by setting out clear steps for an employer to take to create a safe workplace. The specific duties may either:

- Prohibit particular activities in the workplace,
- Direct the plant,
- Ensure that machinery and equipment comply with specifications, or

- Require the use of safety devices or protective equipment.

An employer must comply and ensure compliance with the general duties and any specific duties relevant to its undertaking.

#### **3.4.2.1 Employers' duties**

If a claim is made against the employer, the first step is to for the employee to prove that the employers act (or omission) has in fact caused the injury. Once this is done, the focus turns to whether the employer has met the required standards of care. This inquiry consists of two parts. Firstly it is to be determined whether the harm caused could have been foreseen or predicted. It is immaterial whether the employer foresaw the accident or not, the issue is whether it could have been foreseen. If the answer is yes then, secondly it is to be determined whether the employer took reasonable steps to prevent the accident. The steps that the employer should have taken to avoid an accident are determined by balancing the following:

- The seriousness of the harm to be guarded against (severity of possible injury and the number of people at risk).
- Probability of the incident happening.
- The degree of risk involved in taking the precautions.
- Cost of taking the precautions.
- Difficulty of taking the precautions.

The greater the seriousness or probability of harm, the greater will be the necessity for taking safety precautions.

The act requires the employer to establish the hazards attached to any work which is performed through a process of risk assessment. The employer must undertake three activities for this process:

- Identify the hazards which are present in the workplace.
- Assess the risks posed to employees' health and safety.
- Take steps to eliminate or mitigate these hazards.

The employer must strive to remove any hazard, only if this is not reasonably practical can he/she seek to comply with the statutory duties by mitigating the hazard. Only if it is not reasonably practical to mitigate a hazard through engineering controls or other means, can the employer resort to personal protective equipment.

The first and overriding priority is to avoid risk i.e. the design of new workplaces and processes should not utilise dangerous processes where safe or less dangerous alternatives exist. Where hazards are discovered in a workplace, all reasonable practical actions should be taken to eliminate them at the source.

An employer may not permit work to be performed or any activities to take place unless the precautionary measures required by the general duties and any applicable regulation or standard are followed. The employer must train employees on the correct use and maintenance of safety equipment.

The provision of competent supervisory staff is an integral part of the provision of a safe system at the workplace. The supervisor staff must have sufficient knowledge to enable them to supervise work, communicate potential hazards and take appropriate steps in emergencies.

Employers must provide information, instructions, training and supervision which may be necessary to ensure their employees health and safety at work. The employer must make sure that the employees are aware and conversant with hazards attached to any work they may perform, any substance they may come into contact with or any plant or machinery they may use.

#### **3.4.2.2 Employees' duties**

Employees are contractually obliged to comply with the lawful and reasonable instructions of their employer – a duty reinforced by statute. However they have an independent duty to ensure that their actions do not endanger their own health and safety and that of others. It is a criminal offence for an employee to:

- Fail to comply with the inspectorate

- Intentionally or recklessly interfere with, damage or misuse anything provided in the interest of health and safety
- Tamper with or misuse any safety equipment
- Fail to use any safety equipment that has been provided
- Wilfully do anything reckless at a workplace, or in connection with the use of a plant or machinery which threatens the safety of any person.

The OH&S Act introduces a series of obligations for the designers and manufacturers of articles and substances that will be used in workplaces, as well as for those involved in marketing these articles and substances. Designers and manufacturers of all articles used at work are required to ensure that the article is safe and without risks to health and safety when used properly and that it complies with all prescribed requirements.

#### **3.4.2.3 Health and Safety Representative**

Every employer with more than 20 employees at any workplace must appoint a health and safety representative (HSR). There must be one representative for every 50 employees in a workplace, except in shops and offices where there need only be one representative for every 100 employees. The employer and employees must agree on the manner in which an HSR is elected, normally nominated and/or elected.

#### **3.4.2.4 Operational Health and Safety Assessment**

The Occupational Health and Safety Assessment or OHSAS 18000 done through the SABS is a management system series used to assess and certify the organisation against the OH&S Act.

The OH&S Act is in itself regulation and deviation from this act can result in a criminal offence. For this reason, the OH&S Act is going to be used as a reference in the remainder of this text. As long as the act is followed, OHSAS 18000 or the

like is not necessary as there is not much benefit from it (excepting that it might help in the integration of OH&S with the other standards), the act still has to be adhered to. OHSAS 18000 can later be consulted in order for an assessment to be performed if required at a later date.

### **3.4.3 Implementation**

Safety is to be driven from the top and is to be seen as one of the prime business goal.

Safety management needs to be applied to three major areas of any operation nl: plant, safety management systems and people. Management involvement is to include setting targets, drawing up plans and doing frequent inspections.

A lot of the good practices and standards which should be implemented would normally come from learning from one's accident and incidents. Some of these have already been learnt the hard way. From now on though, the most visible and common dangers will be obtained from various other sources and for most of the smaller, more industry-specific dangers, other organizations in the same industry sector are to be looked at to try in order to prevent as many accidents and incidents as possible.

Instead of a reactive system only focusing on accidents and incidents, a proactive system is to be implemented through auditing inputs such as training, emergency procedures, PPE management etc.

#### **3.4.3.1 Recommendations**

Safety is to be seen as the dominant objective of the organization above production, costs etc. and a policy is to be drawn up reflecting this.

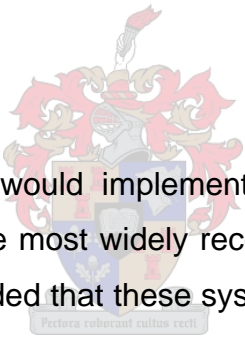
Safety audits are to be performed on a regular basis and are to be done by senior management who are to be trained in doing such safety audits.

Full union and employee involvement is to be sought.

The employee and management raises are to be negatively affected in the departments where there is a dip in the safety performance. In order for this to be carried out, an audit system is to be in place and the safety performance is to be benchmarked.

A safety procedure is to be drawn up containing all the principles that are decided upon by management. Management are to have regular meetings in order to understand and better any safety issues and to discuss all possible solutions.

### **3.5 Chapter Summary**



Reasons why an organisation would implement an EMS, QMS or OH&S are investigated. Because ISO is the most widely recognized standard for both EMSs and QMSs in the world it is decided that these systems (ISO 14000 and ISO 9000) are to be implemented in the company. The key elements of ISO 14000 are broken down and discussed as well as the with the basic principles of the ISO 9000 system.

While EMSs and QMSs are simply good management and marketing tools, OH&S is law and has to be conformed to. There are various duties which the employer as well as employee have to conform to. A brief overview of what OH&S is, what the act entails and some of these duties are discussed.

Having discussed EMSs, QMSs and OH&S, integration is now to be done before implementation can begin.

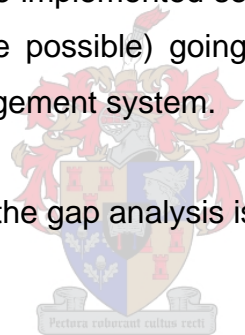
## 4. Integration and Gap Analysis

Having discussed EMSs, QMSs and OH&S separately, a gap analysis is now going to be done for each of them and then the different systems are going to be integrated.

### 4.1 Gap Analysis

To start with, three different gap analyses are going to be performed for the three management systems to be implemented. After this, the sections which the company does not have in place or are incomplete, are going to be, if possible, integrated (4.2 Integration) and implemented. The sections which cannot be integrated are simply going to be implemented separately. Where existing sections are complete, these are (where possible) going to be integrated. This will then create a totally integrated management system.

The process of integration from the gap analysis is shown in Figure 4-1.





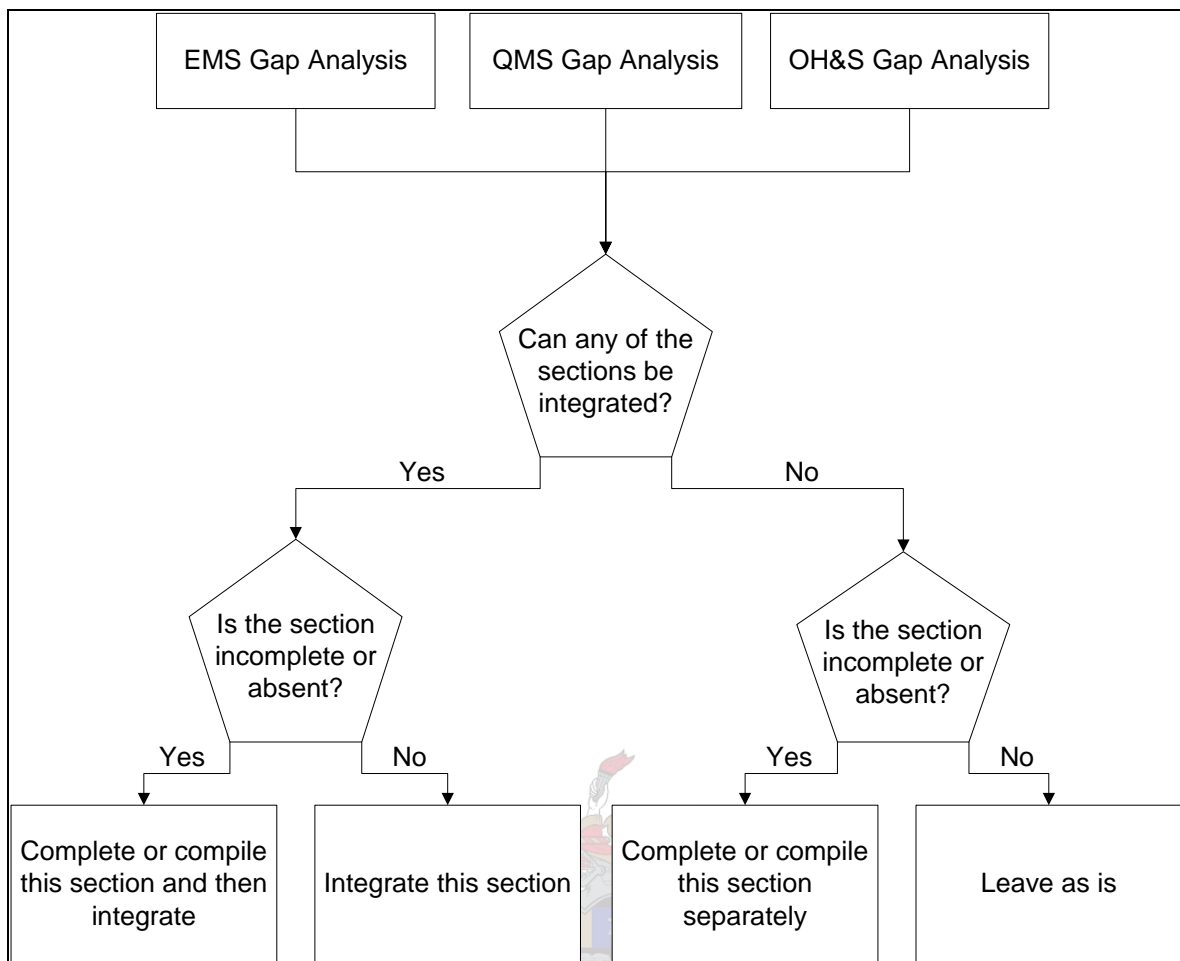


Figure 4-1: The mind map showing how integration is to be done from the gap analysis

Sections which can be integrated are highlighted as bold. Those sections which are not bold, which can't be integrated are to be implemented separately.

#### 4.1.1 EMS Gap Analysis

Table 4-1 shows the gap analysis done according to the ISO 14000 structure.

Table 4-1: EMS gap analysis

No.	Query	Y	N	Comments / Motivation
1	Is top management fully committed? Have sufficient funds and resources (time) been provided?		X	Not fully committed. See chapter 7.1 Management Commitment
2	Does the organisation have any other management systems in place?		X	
	If yes:			
	ISO 9000			
	ISO 14000			
	HACCP			
	SAP			
	BS 7750			
	EMAS			
	Other			
3	Has the organisation got any experience in EMS, EIA, LCA etc? (Specify)		X	
4	Does the company have a corporate code of practice/charter or policy? (Specify)		X	
5	Are any of the mentioned management system procedures in place?			
	<b>Environmental Aspects</b>		X	
	Legal and Other Requirements		X	
	<b>Structure and Responsibilities</b>		X	
	<b>Training, Awareness and Competence</b>		X	
	<b>Internal communication</b>		X	
	<b>External communication</b>		X	
	<b>Document control</b>		X	
	Operational Control		X	
	<b>Emergency preparedness</b>		X	
	<b>Monitoring and Measurement</b>		X	
	<b>Corrective/Preventive Action</b>		X	
	<b>Records Management</b>		X	
	<b>Management System Audit</b>		X	
	<b>Management Reviews</b>		X	
6	Do the suppliers, subcontractors or customer have any specific requirements?		X	
7	Are process or organisational flow diagrams available?		X	These are in the process of being compiled

There are no environmental procedures in place at the moment therefore these are not going to be discussed in further detail. In order to do a more in-depth gap analysis for the EMS certification, refer to GEMI (2000)

#### 4.1.2 QMS Gap Analysis

Table 4-2 shows the gap analysis done according to the ISO 9000 structure.

Table 4-2: QMS gap analysis

No.	Query	Y	N	Comments / Motivation
See No 1,2,3,4,6 & 7 of the EMS gap analysis				
1	Are any of the mentioned management system procedures in place?			
	<b>Documentation Requirements</b>		x	
	Customer Focus		x	
	<b>Planning</b>		x	
	<b>Responsibility, Authority and Communication</b>		x	
	<b>Management Review</b>		x	
	Provision of Resources		x	
	<b>Human Resources</b>		x	
	Infrastructure		x	
	<b>Work Environment</b>		x	
	Planning of Product Realisation		x	
	Customer Related Processes		x	
	Design and Development		x	
	Purchasing		x	
	Production and Service Provision		x	
	<b>Control of Monitoring and Measurement Devices</b>		x	
	<b>Monitoring and Measurement</b>		x	
	<b>Control of Non-conformance Products</b>		x	
	Analysis of Data		x	

There are no quality procedures in place at the moment therefore these are not going to be discussed in further detail.

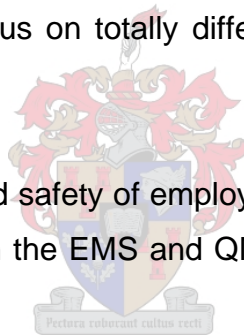
### 4.1.3 OH&S Gap Analysis

The gap analysis for OH&S is different to those above as it is more focussed on practical issues for specific factors and not simply broad concepts. For this reason the gap analysis is quite lengthy and can be found in Appendix C.

## 4.2 Integration

A QMS is aimed at meeting customer requirements, control of the process and continuous improvement while an EMS is aimed at these, and more, including regulatory and other mandatory environmental requirements, addressing priorities and objectives and the needs of a broad range of interested parties and the evolving need of society for environmental protection. Although not one of the two systems is superior as they focus on totally different aspects of an organisation, there is some overlapping.

OH&S is aimed at the health and safety of employees and the public. Although it is a totally different system to both the EMS and QMS, there are still sections which overlap.



If these overlapping sections can be integrated into an integrated management system, it would prevent duplication, thus a lot of resources including time, money and energy can be saved. It would also increase the effectiveness and efficiency of the system as a whole.

Table 4-3, based on the ISO 14000 structure, identifies sections for the different systems which are the same, overlap or use the same basic theory. Only sections from the OH&S Act which coincide with those of the ISO 9000 or ISO 14000 systems are shown as there are too many sections which do not coincide to list them all.

Table 4-3: ISO 14000, ISO 9000 and OH&S comparison table

ISO 14000	9000	OH&S	OH&S	14000	ISO 9000
4.1 General Requirements					
4.2 Environmental Policy	5.1, 5.3	Act - 7			
4.3 Planning					4 Quality Management System
4.3.1 Environmental Aspects		Reg 2-2(1)			4.1 General Requirements
4.3.2 Legal and Other Requirements				4.4.4, 4.4.5	4.2 Documentation Requirements
4.3.3 Objectives and Targets	5.4				5 Management Responsibility
4.3.4 Environmental Management Programs			Act - 7	4.2	5.1 Management Commitment
4.4 Implementation and Operation					5.2 Customer Focus
4.4.1 Structure and Responsibility	5.5	Act - 17(1)	Act - 7	4.2	5.3 Quality Policy
4.4.2 Training, Awareness and Competence	6.2	Act - 13(a)		4.3.3	5.4 Planning
4.4.3 Communication	5.5		Act - 17(1)	4.4.1, 4.4.3	5.5 Responsibility, Authority and Communication
4.4.4 EMS Documentation	4.2			4.6	5.6 Management Review
4.4.5 Document Control	4.2				6 Resource Management
4.4.6 Operational Control					6.1 Provision of Resources
4.4.7 Emergency Preparedness and Response		Reg 2-3, Reg 2-2(5), Reg 1-7(1)		4.4.2	6.2 Human Resources
4.5 Checking and Corrective Action					6.3 Infrastructure
4.5.1 Monitoring and Measurement	7.6, 8.2	Reg 17-6(1), Reg 17-5	Act - 8		6.4 Work Environment
4.5.2 Non-conformance and corrective and preventive action	8.3				7 Product Realization
4.5.3 Records		Reg 1-8			7.1 Planning of Product Realisation
4.5.4 Environmental management system audit	8.2				7.2 Customer - Related Processes
4.6 Management Review	5.6, 7.1				7.3 Design and Development
					7.4 Purchasing
					7.5 Production and Service Provision
				4.5.1	7.6 Control of Monitoring and Measurement Devices
					8 Measurement, Analysis and Improvement
					8.1 General
			Reg 17-6(1), Reg 17-5	4.5.1	8.2 Monitoring and Measurement
				4.5.2	8.3 Control of Nonconforming Products
					8.4 Analysis of Data
				4.6	8.5 Improvement

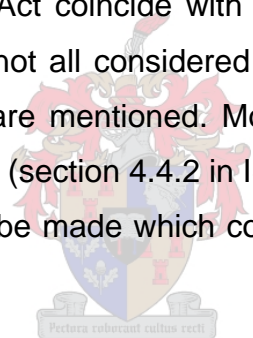
\* All sections referred to on the left half of the table coincide with the ISO 14000 system, while those on the right coincide with the ISO 9000 system.

\* Numbering refers to the sections of the different standards and act.

From Table 4-3 it can be seen that 4.2 Environmental Policy coincides with ISO 9000 section 5.1 and 5.3 which are Management Commitment and Quality Policy respectively as well as OH&S, section 7 which is the OH&S Policy. It can be seen that these sections can now be integrated.

As can be seen from Table 4-3, there are various sections that are either the same, overlap or have the same basis. For those sections which are the same, only one such section needs to be done in order to integrate the systems. For sections which overlap or have the same basis, the section would have to be modified in order to incorporate everything needed for both systems. This takes a little effort at the beginning but once done it makes the operation of such sections easier than if they were kept separate.

Various sections in the OH&S Act coincide with sections of ISO 14000 and ISO 9000 to some degree, but are not all considered in Table 4-3 for simplicity sake. The major sections, however, are mentioned. Most of what is in the OH&S gap analysis (Appendix C) is training (section 4.4.2 in ISO 14000 and section 6.2 in ISO 9000) and physical changes to be made which could be put in the aspect register (section 4.3.1 in ISO 14 000).



## **4.3 Sections To Be Integrated and Implemented**

The sections which are the same, overlapping or have the same basis and how the integration is to be performed are discussed below. The structure is based on the ISO 14000 system.

### **4.3.1 Policy**

There are to be three separate policies, an environmental policy, quality policy and a health and safety policy. These are kept separate because they will be audited and certified as separate systems, for simplicity and so the employees and public

(anybody seeing the displayed policies) can clearly and easily distinguish between the three.

### **4.3.2 Management Representative**

During implementation there is going to be an environmental management representative, quality management representative as well as a health and safety representative. Once implementation is complete and running smoothly, a single person will be chosen to be the 'integrated management representative'.

### **4.3.3 Document Control**

Instead of having separate work instructions for the EMS, QMS and health and safety system as well as other Operational Work Instructions, all work instructions are compiled for every task that is to be performed in the company and filed together. This makes it easier to find a particular work instruction and prevents duplication. Integrating the work instructions leads to very large numbers of work instructions making it easy to omit some aspects. It is still necessary to check whether all aspects of the different systems are actually covered.

### **4.3.4 Emergency Preparedness and Response**

The emergency preparedness and response procedure specified in ISO 14000 is to also include applicable health and safety aspects in order for the company to comply with the OH&S Act. OH&S issues are to be discussed in the management meetings which are to be held semi-annually or when necessary.

### **4.3.5 Aspect Identification**

The aspect identification section is to include environmental aspects as required by ISO 14000, and safety aspects as required by the OH&S Act.

#### **4.3.6 Legal and Other Requirements**

All internal and external requirements regarding company specific regulations, pertaining to the EMS are to be identified and regularly reviewed.

#### **4.3.7 Objectives and Targets**

The objectives and targets although slightly different (between ISO 14000 and ISO 9000) will be completely integrated.

#### **4.3.8 Management Programs**

Management programs are necessary for both ISO 14000 and ISO 9000 and will be integrated.



Both the objectives and targets as well as the management program are to be incorporated into the aspect register, this means that a single, easy to read, document will incorporate all three sections.

### **4.4 Implementation and Operation**

#### **4.4.1 Structure and Responsibility**

All roles, responsibilities and authorities related to the management systems are delegated and described in the various applicable procedures including a company organogram and the job descriptions for each employee.



## **4.4.2 Training, Awareness and Competence**

A proper awareness and competency training program is to be set up with regards to:

- The importance of the three management systems;
- Significant impacts of their work activities and the benefits of improved personnel performance;
- Their roles and responsibilities in achieving conformance with the requirements of the management system;
- The potential consequences of departure from specified operating procedures.

A new employees handbook (HR Handbook) is to be developed and given to each employee as well as new employees when they start work describing all the general aspects of the company eg: working times, holidays, procedures, policies etc.

Procedures for all aspects of the company are to be drawn up and training is to be done from these procedures and recorded in a personnel training file and/or individual personnel files. Besides being compulsory, recording of personnel training will also help in finding a replacement for an employee if he/she is not at work or able to perform the task.

## **4.4.3 Communication**

### **4.4.3.1 Internal Communication**

Procedures for formal internal communications of the management systems are to be compiled. The company is in the process of installing an intranet which would make the formal communication documentation much easier via intranet and e-

mail. Vast amounts of training are to be done in order to train employees to use the e-mail facilities effectively.

Outstanding internal communication forms are also to be compiled for the employees working in the factory eg: suggestion forms, complaint forms, etc.

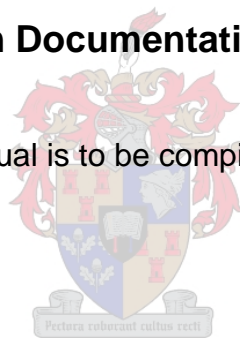
#### **4.4.3.2 External Communication**

Procedures for external communications are to be compiled. Whether a single person for each system is going to do the external communications for the different systems or whether different people for each system are going to be responsible for the external communications is to be decided.

#### **4.4.4 Management System Documentation**

An integrated management manual is to be compiled.

#### **4.4.5 Operational Control**



The operations and activities associated with the aspects listed in the Aspect Register (3.2.3.1.2 Environmental aspects) are:

- Documented and controlled where necessary to ensure conformance to the requirements;
- Made visible to suppliers and contractors where applicable to ensure that these are documented and controlled by them to ensure conformance to requirements.

### **4.5 Checking and Corrective Action**

The effective operation of the integrated system is maintained through the following measures:

- Monitoring and measurement
- Non conformance and corrective and preventive action
- Records
- Management system audit

The measures listed above for the three systems are to be completely integrated.

## 4.6 Management review

Separate reviews are to be done until the implementation of the integrated system is complete then the entire integrated management system is to be reviewed periodically and improved.

## 4.7 Additional Sections

The work environment is to be implemented according to ISO 9000 considering all the related aspects in the OH&S Act.



Sections from the three systems which are not the same or overlapping are shown in the gap analyses (given in section 4.1) as “not bold”, these are already discussed in their appropriate sections and thus will not be discussed further.

## 4.8 Summary Of Gap Analysis For The Management Systems

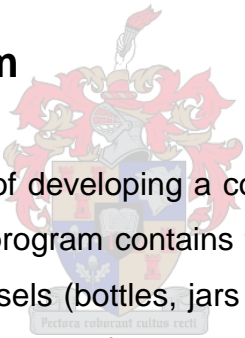
All three management systems have been discussed, a gap analysis of each has been performed and integration has been discussed. These are all theoretical concepts mostly being done on paper (excepting for the OH&S section), which lead

to actions being taken. The practical concepts or actions themselves are still to be discussed.

Having discussed the different management systems to be implemented and the integration of these, the practical side is now covered. The following section will focus on suggestions of aspects which have to be implemented, changed or improved in the organisation in general including computer program, MSDSs, offices and maintenance amongst others, after which the different functional departments will be considered.

This, and the following chapters alone will not provide enough information to implement a complete integrated management system and should therefore, be used in conjunction with the previous sections (especially the gap analysis).

## **4.9 Computer Program**



The company is in the process of developing a computer program to control most of its' processes. Currently the program contains the data of all the raw materials, product formulas and empty vessels (bottles, jars boxes etc.) along with quantities from which production can be done. If a certain product is to be produced, a production order is printed. From this the product receives a batch number and all the items to make up the product are removed from the stock figures. If there is not enough of a certain item making up the final product, the production order cannot be issued to produce the product. There is also a financial section from which the costing is done.

All transactions are recorded for quality reasons and any information to do with a product can be found. Simply by putting the batch number into the computer, what raw materials (incl. batch number) went into the product, what vessels (incl. batch numbers) were used, when those raw materials and empties were received and from which supplier, can be accessed

There are many processes which should be implemented into the program and which would help to streamline the integrated management system implementation and maintenance. It is possible to implement these processes as the program was designed to be expanded from the start. Some processes which should be integrated into the program are:

- Authorisation: Once implemented, every major action has to be authorised before it can continue. An example of this is if an order is placed for a raw material by the store manager, it has to be authorised by the purchasing department.
- Equipment and machinery availability: Once implemented, the program would allocate a specific set of equipment and machinery to the manufacture of a product, and once allocated can only be freed when the product has passed quality control. This is done so that a product can only be produced if all the equipment and machinery needed is actually available.
- Machinery maintenance: Once implemented, this would remind the maintenance department of scheduled periodic machinery maintenance, schedule machinery for maintenance if faulty and record a history of all maintenance done to machinery.
- Employee training: Once implemented, all the employees training and qualifications can be put onto the computer and employees can be assigned to tasks that they are trained or qualified for.
- Quarantine: Once implemented, all inventory items would be received but would only be made available for use once they have been checked (either by visual inspection, laboratory test or other means) and authorised.
- Laboratory results: Once implemented, all laboratory results would be entered into the computer (for both raw materials coming in and for final products produced) for quality purposes.

## 4.10 Suggestions

- ✘ None of the incoming goods (raw materials, packaging material, etc.) are checked for quality, none of the ambient conditions are monitored or regulated and no machinery is checked to be consistent. All of these add to the quality and consistency of the finished product, which decreases when these checks are not done.
- ✓ Procedures are to be put in place in order to check the quality of the incoming goods. A quarantine area (either physical or theoretical) would be a good idea where incoming goods can only be released once the quality has been passed. The external ambient conditions are to be monitored and benchmarked with their effects on the final product assessed. Machinery is to be checked for consistence and kept in the same state of repair. A proper maintenance schedule is to be drawn up and adhered to.
- ✘ There are very few employees wearing the necessary safety equipment. This is not because the safety equipment is not available but because they are not adequately trained on what safety equipment to wear and supervisors are not strict enough to enforce that the necessary safety equipment is worn.
- ✓ Before any training can be done, it has to be ascertained what safety equipment is to be worn with what raw materials and/or processes. First every raw materials' Material Safety Data Sheet (MSDS) is to be examined and it must be determined what safety equipment needs to be used with different raw materials. Then, both the workers and the supervisors are to be properly trained. Stricter control is to be enforced. The workers must receive and have access to the appropriate safety equipment for the raw materials they will be working with. It is then the supervisors' responsibility to ensure that the required safety equipment is worn, if a worker is caught without the required safety equipment, the supervisor is to take appropriate action.

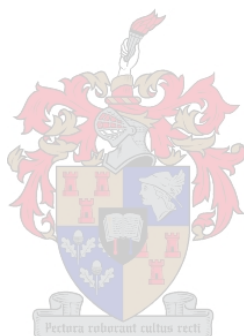
- ✘ Some employees refuse to do certain work because they say that it isn't their job and supervisors do not take responsibility for anything. All responsibility lies with the production manager.
- ✓ Job descriptions and work instructions are to be drawn up for each employee.
  
- ✘ People stand around talking or go to other people to talk when they have not been given work or when they are waiting for work.
- ✓ These people are not only wasting their time but the time of the person they are talking to, who might have something to do urgently or needs to concentrate. Strict supervision will have to be enforced to get these people into the habit of doing something else (like housekeeping, administration, etc.) when they have not been given work or while they are waiting for work.
  
- ✘ The quality of goods received from suppliers is often below specification.
- ✓ All suppliers are to be informed of the companies' quality standards and that the suppliers are to conform to the same high standards. If this does not happen then alternative suppliers should be sought.
  
- ✘ There are a large amount of raw materials and empties which are listed in the computer but are not used anymore as they are either discontinued, replaced or the product they were in has been discontinued and there is nothing in stock. This slows down not only the computer with unnecessary bulk but also wastes a lot of time when a user is looking to find a raw material or empty in the list to use it. There are also a lot of repeat entries in the computer due to many reasons incl. misspelt names, different owners, code mistakes
- ✓ The raw material and empties list should be investigated and all unnecessary items should be taken off, repeat entries should also be removed.

## 4.11 Chapter Summary

This chapter focussed on the organisation in general and it can be seen that the major issue is training. In the remainder of this text training will continue to be a major factor that has to be overcome before any real changes will be seen.

Improvements to the computer program are considered and MSDSs are investigated in order to determine which chemicals are hazardous. The offices and maintenance have a few small issues including safety, communication, and cleaning issues.

The following chapters will now highlight aspects in the different functional departments of the organisation.





## 5. Inventory, Production and Administration

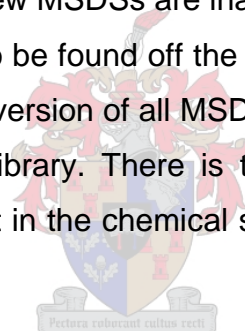
### 5.1 Inventory

In this chapter the inventory departments including the chemical store, empties store, finished goods store and supplies will be considered.

#### 5.1.1 Raw Materials

##### 5.1.1.1 Material Safety Data Sheets

- ✕ There were only MSDSs for about 100 of the more than 1700 raw materials and they could only be found in the production managers' office. If the production manager is not there, these few MSDSs are inaccessible.
- ✓ The remaining MSDS's are to be found off the internet or through contacting the supplier. A network software version of all MSDS's is to be available as well as a hard copy in the company library. There is to be a MSDS for all potentially hazardous raw materials kept in the chemical store or room where the chemical is stored.



##### 5.1.1.2 MSDS Analysis

###### Method

Each raw material MSDS was evaluated at for health hazards (LD<sub>50</sub> (Lethal Dose), physical effects, hazard rating etc.) and environmental hazards (biodegradability, bioaccumulation etc). Each raw material was assigned a rating out of five for both health and environmental hazards, those raw materials that could pose either a health or environmental danger (which was a rating higher than three) were then looked at and the following two factors were considered in order to decide whether the raw material posed a health and/or environmental threat:

- The highest percentage raw material in any one product. This will show whether the raw material poses a health or environmental threat whilst in the product.
- The maximum amount of the chemicals kept in stock at any one time. This shows whether the raw material poses a health or environmental threat before being put into the product. Potentially hazardous raw materials with a maximum stock level of more than 100 kg were separated as well as any raw material with a hazard rating of five for either environmental or health risk and any raw material with four for both environmental and health risks.

A section of the results are shown in Appendix D. It was determined from this information whether the raw material has a significant probability of causing health and environmental damage.

## Results

In most instances the hazardous raw material is in the product in such small percentages that it renders it harmless in the product. There are products such as cream peroxide that do pose slight health hazards but this is the foundation of the product. The product would not work if it wasn't for the burning properties of the raw material therefore no alternatives can be considered. All the potentially hazardous raw materials which are found in products in significant amounts are there for this reason – as the active ingredient. Therefore there are no significant amounts of a raw material which can be changed.

Most of the chemicals have been investigated and out of the more than 1500 raw materials found in the computer, it was found that 57 of them are potentially hazardous to the environment and/or human health as can be seen in Table 5-1. This may seem like a very low percentage but considering that almost 500 of those raw materials are perfumes and colours and that the company makes hair products which are not very harmful to human health, this is actually not a very low number.

Next are the raw materials which pose health and environmental hazards before being processed into the product. The quantity which is kept in stock has an effect as to the significance of the hazard it poses, i.e. smaller quantities pose an almost insignificant hazardous threat (depending very much on the extremity of the hazard of the raw material)

Table 5-1: Number of potentially hazardous raw materials

	Environmentally Hazardous only	Health Hazard only	Both	Total
Insignificant	4	7	8	19
Significant Quantity	6	5	27	38
Total	10	12	35	57

Table 5-1 shows a summary of the numbers of chemicals kept in significant and insignificant quantities. Appendix D shows the maximum quantity of the hazardous raw materials which will be kept in stock at any one time as well as how hazardous (rated 1 – 5) the raw material is. It is difficult to say what a significant and insignificant quantity is as this would depend on how hazardous the material is and in what way it is hazardous. More hazardous materials which are kept in lesser quantities could still pose just as much a hazard, if not, more of a hazard than a less hazardous material which is kept in vast quantities. For this reason each raw material was considered individually (with reference to the raw materials MSDS, literature in books and on the internet) when determining if it is kept in a significant quantity or not.

From this it can be seen that only a few raw materials (listed in Table 5-2) are kept in such quantities as to pose a health or environmental hazard.

Table 5-2: List of hazardous raw materials

ABILQUAT 3474	LUVIQUAT FC 550
AMMONIA 25%	MAGNESIUM PEROXIDE 25%
AMMONIUM BICARBONATE	MONOETHANOLAMINE
AMMONIUM CARBONATE	N CETYLPYRIDINE CHLORIDE MONOHYDRATE
AMMONIUM PERSULPHATE	PHENOXETOL
AMMONIUM THIOGLYCOLATE 70%	PHOSPHORIC ACID 85%
BENZYL ALCOHOL	POLYQUATERNIUM 11
BUTYL OXITOL	POTASSIUM PERSULPHATE
CETRIMONIUM BROMIDE	SILIC F/GUM BLEND 1214
CETRIMONIUM CHLORIDE 50%	SODIUM HYDROXIDE
DIOCTYL MALEAT	SODIUM HYDROXIDE 25%
EDTA DISODIUM SALT	SODIUM ISOASCORBATE
FORMALDEHYDE 40%	SODIUM NITRITE
GLUCOSE	SODIUM PERSULPHATE
GLYCEROL MONOTHIOGLYCOLATE 75%	SULPHONIC ACID
HEXALINE GLYCOL	SURFADONE LP 300
HYDROGEN PEROXIDE 50%	THIOGLYCOLIC ACID 99%
INCROQUAT SDQ - 25	THIOLACTIC ACID
LACTIC ACID 80%	TRIETHANOLAMINE 99%
LITHIUM HYDROXIDE	

Non-hazardous alternatives to the raw materials listed in Table 5-2 are to be looked at as far as is reasonably practical. For those which are not reasonably practical, they are to be stored in a separate chemical store or a specially designed locked container (cupboard) and handled with extreme care.

### 5.1.2 Chemical Store

- ✘ There are over 1500 different chemicals stored on the premises. This is a large number of chemicals which leads to a large number of possible problems and risks which could occur. As the number of different chemicals increases so does the risk of weighing out the incorrect chemical, increases in probability of spillage, increases in storage costs, mixing of chemicals which become dangerous when mixed, etc.
- ✓ There are a substantial number of chemicals which perform basically the same task in the finished product. This means that instead of having eight different chemicals, for example, used for hair conditioning, only three or so can be used therefore eliminating five alternatives. It is difficult to eliminate all of the other chemicals and only work with one especially because most of them, although primarily serving the same function, do have different properties like some are oil soluble while others are water soluble. This partial elimination will decrease the amount of orders which have to be made, increase the turnaround time for a specific chemical, decrease space requirements and decrease the probability of something going wrong. This process will not cost any money because once the chemical is finished it is simply not ordered anymore
- ✘ Hazardous liquid raw materials are in drums without any bund walls around them. This is dangerous because if spillages occur, not only is it a serious health hazard, but there is nothing preventing the hazardous chemical from entering the ground or municipal water system.
- ✓ All drums containing significant amounts of hazardous chemicals (as described in 5.1.1 Raw Materials) are to be banded and kept separate from the other raw materials. Each drum is to be banded separately to avoid any mixing of the chemicals if they are to spill.
- ✘ There is no ventilation in the chemical store which poses serious health hazards because there are chemicals that have low vapour pressures and are not to be inhaled.

- ✓ An extraction type ventilation system should be installed.
- ✗ The chemicals are separated, with different groups grouped together. The problem is that the different groups are placed next to each other in alphabetical order, which could cause problems, eg. acids and alkalis are next to each other. Within each group, the store keeper tries to put the chemicals in numerical order, being numbered according to the order in which they are fed to the computer, i.e. the order in which they are ordered for the first time (this is not always possible because different raw materials are in different sized containers and some cannot be placed on shelves, etc. In the end there is no real order and this means that some incompatible raw materials are placed next to each other.
- ✓ The different groups are to be placed in an order as to minimise the threat of incompatible groups (these can be found in any chemical or good manufacturing practices manual) close to each other from reacting, thus incompatible groups are to be placed as far apart as possible or in separate locked cupboards or containers within the store. The order of raw materials within a group is to be considered so that incompatible raw materials within a group are placed as far apart as possible.
- ✗ Incoming water as well as deionised/softened water are not tested
- ✓ Incoming water quality is to be tested on a weekly basis in order to ensure that the quality of water used in products conforms to set limits set out in the procedures.
- ✗ The floor of the chemical store is not correct for chemicals, one side is raw concrete and the other is metal sheeting which has holes in it. There is also no gutter system to drain any spills or to drain the water from the cleaning of spills.
- ✓ The holes in the metal sheeting are to be welded closed and the entire floor is to be coated with a chemical resistant floor coating.

- ✘ There are many raw materials in the chemical store which are not used any longer due to the product they were used in changed or the range ended and are now obsolete and take up space.
- ✓ These raw materials are to be used in other products and sold as once off products or if possible used as an alternative raw material in a product until it is finished.

### **5.1.3 Empty Containers/Vessels For Final Product**

- ✘ The empties store is overcrowded, one battles to walk through the store, let alone get anything out due to the large amount of empties. The store is also a mess, there is no order in which the empties are in. The packing of the empty vessels is unsafe because boxes are stacked very high and are unstable, there are also empties lying around everywhere.
- ✓ Improved shelving should be put up to increase the space for packing. Space will only be a problem until the next building is complete as a large area is to be used for empties storage. This will, however, not help to make the store look less of a mess. This can only be done through training. The store-keeper is to be trained on how to keep the store neat, systematic (size, type and shape of empties grouped together), safe and should include proper storage techniques. The store-keeper is also to rearrange all the empties into some kind of order to make it easier to find the empties.

### **5.1.4 Finished Products**

- ✘ The finished goods store is also overcrowded due to lack of space and poor storage techniques. In some places there is only one small box which takes up an entire pallet, while there are full pallets lying in the middle of the walkway, this is a huge waste of space. This store is also a mess as there is no order, goods are packed on the floor in the walkways, single bottles are lying around and there are empty containers also stored in this store.

- ✓ Space is only a small part of the problem, although a large section of the new building is set aside for finished goods, this is not necessary, only a small section should be set aside. The major problem here is storage technique, the store-keeper has also not been trained in proper storage technique and this would help immensely in saving space.
- ✕ There is no system of keeping stock of finished products. When a product starts running low, more is produced but if a customer orders a large amount, the store-keeper first has to physically check how much stock is available.
- ✓ A finished product inventory system should be included into the computer system.

### **5.1.5 Supplies**

Supplies are all consumables not used in the production of goods. These include, amongst others, stationary (including printing paper and ink cartridges), toilet paper, kitchen consumables (coffee, sugar, etc), computer parts and software, protective equipment, etc.

- ✕ The only problem with the supplies section of this organisation is that different employees (managers and supervisors) keep different supplies and they are responsible for giving these to the people that need them. The problem is that they are the only ones with the keys to get to these supplies. If they are off work then nobody can access these supplies.
- ✓ It is suggested that either another person has a spare key for the different areas or that all the supplies be stored in a single room and every appropriate employee has a key for the store. The latter option does have security issues and it would be time consuming for the people to go to a specific store room in order to get the necessary supplies.

## **5.2 Production**



Tanks used for production are product specific i.e. a specific product is produced in a specific tank, although there may be more than one tank for a specific product depending on the size of the batch to be manufactured (eg. Conditioner is manufactured in one of four different sized conditioner tanks). Most of the tanks are on scales in order to weigh out water and chemicals which haven't been issued from the chemical store.

### **5.2.1 General**

- ✗ Pipes used in manufacture and filling are often only rinsed out when tanks are cleaned allowing a build up of algae and bacteria inside the pipe which then goes into the product. Although there are preservatives in the products, it is sometimes not enough to kill the amount of algae or bacteria from the pipes. Products have been returned because of bacteria which made it unacceptable (go off) and because pieces of black fungus were found.
- ✓ When a tank is cleaned, the pipes from the tank should be rinsed with an environmentally friendly anti-bacterial substance in order to keep the pipes clean. This can be done up to once every second month due to the nature of product being produced (preservatives in the products which kill bacteria). All fixed and water pipes are to be washed through once a month in order to keep them free of bacteria, because there are no preservatives in the pipes and often the substance in the pipes is stagnant for long periods of time.
- ✗ The factory looks dirty although people are supposed to keep their work areas clean and free of clutter
- ✓ Getting the person responsible for cleaning (see section 6.1.1) to clean the entire factory once a week is an option, but this would not solve the problem, it would simply give the other employees an excuse not to clean anything even if they messed something, they would simply go looking for the cleaner, wasting even more time. Another solution, and the better one, would be to train the employees to clean their own work areas on a daily basis and have random inspections holding them responsible for their work area. This is important

because a dirty work area has the potential to be unsafe due to spills (slippery, corrosive etc.) and unhygienic (bacteria thrives etc.).

- ✘ Once containers (drums, buckets, measuring cylinders, etc.) or accessories (spatulas, pipes, stirrers) are used, they are simply put down somewhere and forgotten about most of the time, until somebody else needs the same item. They then have to go search for it and clean it (which is often more difficult once the contents has dried, so more water is necessary) before they can use it again.
- ✓ Once a container or accessory is used it should be taken to the wash bay, where the cleaner (see section 6.1.1 Wash Bay) will then clean the item and place it back into a general equipment store. When somebody is looking for the item they will then know where to find it.

### 5.2.2 Manufacture

- ✘ When a production order is placed, all the raw materials are currently being weighed in the chemical store, placed into small containers which are then sent to the appropriate tank where the product is to be produced. This makes things very difficult when chemicals which are used in large quantities (above 100 kg) and/or in a lot of different products are to be weighed. It also makes the weighing of chemicals dangerous when hazardous chemicals have to be weighed and carried around.
- ✓ Tanks with the most commonly used (both quantity and rate) raw materials can be placed on the floor above the manufacturing area with feed lines to the tanks where they will be used. When a raw material is needed, the appropriate tap can simply be opened. This also reduces the risk of an incident with a hazardous chemical.
- ✘ Finished goods which are out of spec (where a wrong raw material was used, raw material was dirty, etc), left over from a previous filling/bottling or from a discontinued range, are simply kept to be recycled back (in small amounts) into

the next batches of the same (or similar) product to be produced. This leads to quality problems as these inputs to the system (recycled finished product) are not kept constant and in most cases are out of spec to begin with. This often leads to the next batch of product being out of spec as well. Not only does this mean that the amount of product which is out of spec grows continuously but also that a lot of time and money is wasted to recycle this finished product.

✓ Any finished product which is left over from filling or which is out of spec but still good enough to use should be sold. There are many ways of selling this extra product, some examples are:

- Selling to the employees although this could mean that they could sabotage the goods in order to get them cheaply for themselves.
- Sell the goods to customers, salons or other vendors as cheap out of spec products.
- Sell to spaza shops as a community development program.

✗ Certain raw materials (mostly thick waxes) used in small quantities need to be heated (sometimes to above 80 °C) before being added to the product. At the moment there is a room where all the heating is done. The heated raw material is then carried (sometimes placed on a trolley) to the other side of the factory to the specific production area. This poses many problems, the most serious of which is the carrying around of hot raw materials which can be spilled causing burns. Due to the distance which has to be covered and the number of people that have to be passed, there is a great chance of an accident occurring.

✓ There are only two production areas that need heated raw materials, therefore it is recommended that the heaters be placed close to these production areas. Time would be saved from walking around to get the raw material heated and would also prevent hot raw materials from having to be carried or pulled on a trolley.

✗ At present when a product is out of specification, an amount of adjustment chemicals to be added is guessed, in order to get the product within

specification. The product is then tested again and another guessed amount is added.

- ✓ This method of trial and error wastes a lot of valuable time and money in that laboratory tests are expensive and laborious. If the adjustment amounts can be benchmarked, when a product is found to be out of specification, the correct amount of adjustment chemical can be added from the start.
- ✗ There are drums lying around with product and/or raw materials in them with:
  - no markings as to the contents of the drum,
  - more than one name and/or batch number on the drum, or
  - the incorrect name and/or bath number on the drum.
- ✓ This can only be overcome by training employees to put batch numbers and names on the drums as soon as they begin to manufacture. Employees should be issued with name cards which are to be attached to the drums as soon as they are used or as soon as they are filled and these cards should follow the product until it is filled or sent to the customer after which the cards are to be filed. If a product is transferred from one drum to another, the cards should also be transferred. With proper training this will prevent any of the mentioned problems.

### **5.2.3 Filling and Packaging**

- ✗ Quite a few finished products that were about to be sent to the customer have been found to have no batch numbers, incorrect batch numbers or more than one batch number and this is after they are supposed to be checked by the supervisor (before being sent to the finished products store).
- ✓ The only way this can be prevented is through training and having another final quality controller checking all products before they are dispatched to the customer.

- ✘ Only two customers' retention samples are kept and this is only done because the customer requested it.
- ✓ Samples of every batch of every product are to be kept for quality control purposes. If products are later returned or complaints for a product are received, the retention sample can be referred to in order to determine what the problem might be.

## 5.3 Administration

### 5.3.1 Offices

There are very few issues (problem aspects) in the office block, some of the small problems are

- ✘ The stairs going to the top floor of the office block and the stairs out the back of the office block are smooth and not safe as they are very slippery when wet.
- ✓ The stairs going to the top floor are to be covered with a non-slip carpet or other non-slip material and the stairs out the back of the offices should be replaced with a safe, sturdy and non-slip staircase.
- ✘ The factory offices do not have a photocopy or fax machine therefore every time anything needs to be copied someone has to walk all the way up to the office block which wastes valuable time and leaves the factory and factory offices unattended.
- ✓ A photocopy machine and fax machine is to be purchased and placed in the factory offices.
- ✘ There is a single phone in the whole factory in one of the offices and this makes it extremely difficult to get hold of anybody in the factory, especially seeing as the person in the office in which the phone is in is often not there.
- ✓ An internal phone system should be looked into for supervisors, managers and employees who need to be in contact with the office or another person with a

cordless phone. This would mean that every person who has a cordless phone will be available no matter where on the premises they are.

- ✗ Customers are treated improperly and without respect. The way in which they are spoken to (in a derogatory manner) is unacceptable, in this instance the saying the customer is always wrong applies.
- ✓ Someone with good people skills is to be employed to deal with the customers and is to be sent on courses to be trained in customer relations.

## **5.4 Maintenance**

- ✗ There is metal, wood and plastic scrap lying around outside making the place look like a scrap yard. Scrap comes from changes made inside the factory and also off cuts and extra material used to make changes inside the factory. The maintenance staff move everything outside and dump it instead of removing it permanently.
- ✓ A recycling company or scrap yard is to be contacted and the scrap removed. A procedure is then to be drawn up specifying what is to be done with any waste material in order to prevent this from happening again. Recycling companies usually supply labelled waste containers for specific waste, this option is to be investigated.
- ✗ The OH&S Act is not adhered to at all, this can be seen from the gap analysis (Appendix C)
- ✓ This is because proper training has not been done to inform the maintenance staff of the regulations in the Act. Training is to be done on a continuous basis and over time changes to the factory, buildings and procedures will be made to adhere to the OH&S Act.

## **5.5 Chapter Summary**

The only major problematic area in the inventory department is the chemical store which needs immediate attention. The other areas only have small issues of which space and training is the biggest.

Cleaning, procedures, training and a few structural changes are what is most required for the production department.

The administration department does not have many issues although safety, communication and cleaning issues need to be addressed.

A water investigation is to be done to determine the water wastage, its' cost to the company, and more ways of how to reduce that cost.



## 6. Water Investigation

Having discussed ways in which to minimize effluent water, the actual current water usage is going to be investigated for different areas in the factory. A few areas in which water usage is to be minimised are suggested and a very basic suggestion of how the effluent is to be handled will be discussed.

### 6.1 Water balance

On average the products contain about 65 % water. Because the products contain such large amounts of water, a large percentage of the incoming water should be going to the product. From Figure 6-1 below it can be seen that this is not the case.

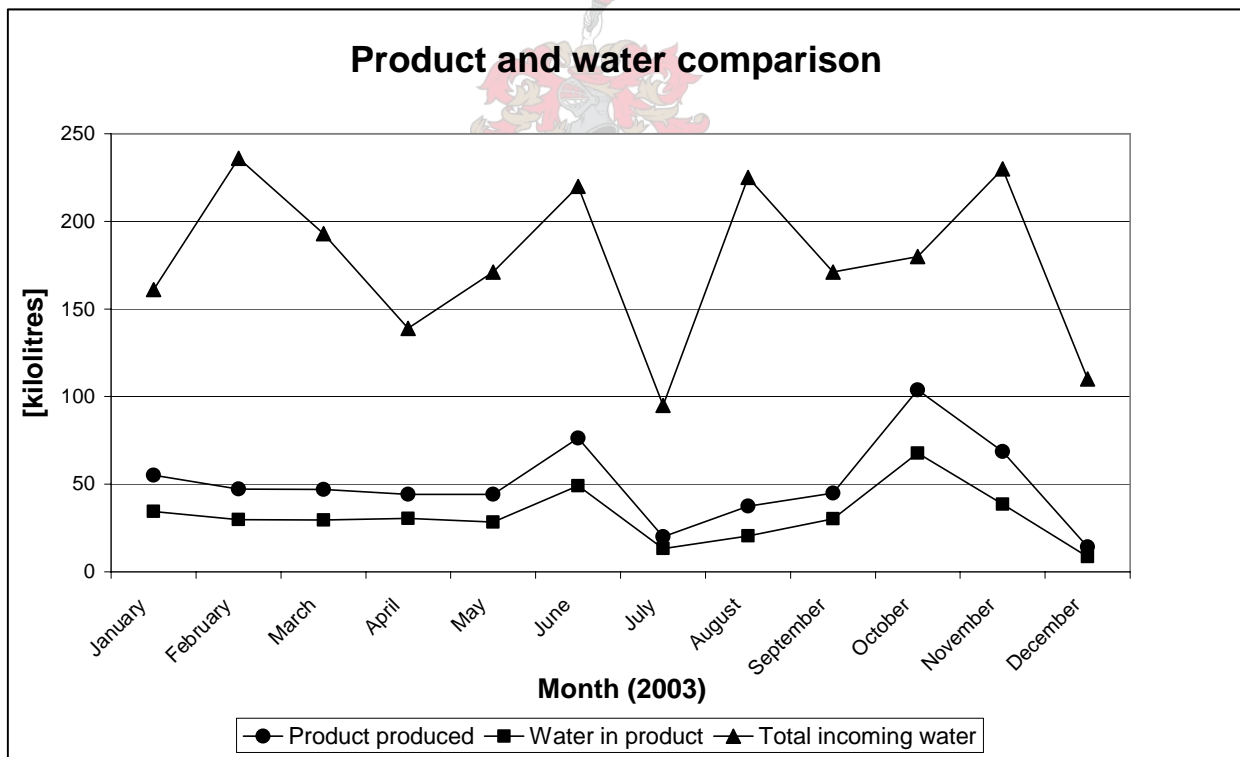


Figure 6-1: Graph of water used in product compared to total incoming water against time



Table 6-1 shows how much water is being used on average, how much water is used per one kilogram of product produced and the average amount of water wasted; per month for 2003. The cost of the water and the monetary value wasted is also calculated from Ekurhuleni Metropolitan Municipality (2003a) and shown in the table.

Table 6-1: Average monthly water consumption for 2003

	Water per product [l water / kg Product]	Total [kl water/month]	Cost of water [R/month]
Total Water used	3.53	177.6	1010
Water actually in product	0.63	31.7	180
Water not in product	<b>2.9</b>	<b>145.9</b>	<b>830</b>

From Table 6-1 it can be seen that there is a quite a large amount of water being used compared to product being produced.

Water measurements were taken during May 2004 – August 2004 and a water balance (Figure 6-2) was compiled to see exactly where all this water is being used.

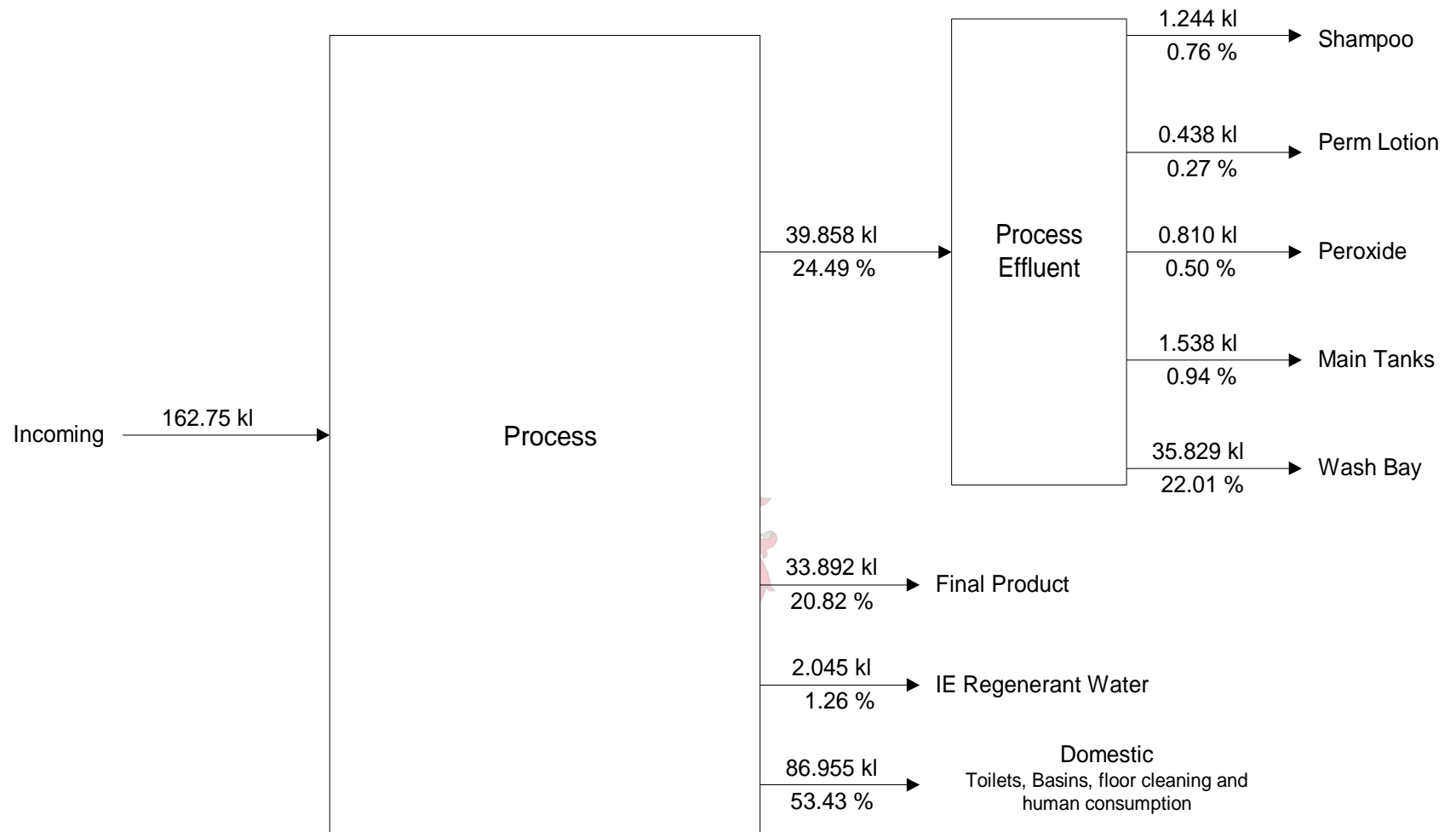


Figure 6-2: Organisation water balance for period May – August 2004 (monthly average values)

As can be seen from Figure 6-2, the wash bay accounts for just as much water wastage as what goes into the product.

### 6.1.1 Wash Bay

The wash bay was investigated over a four month period and a summary of some of the results are shown in Table 6-2.

Table 6-2: Summary of wash bay investigation

	Litres of water
Average daily water reading	1668
Lowest water reading	278
Highest water reading	5076

Figure 6-3 shows the distribution curve for the wash bay effluent in order to try and get an idea of how large the flow variation is.

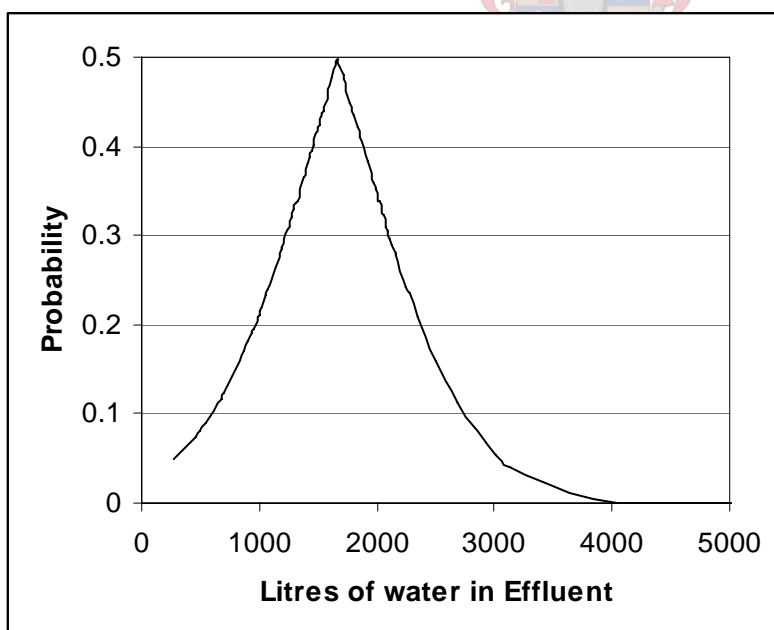


Figure 6-3: Distribution Curve

The distribution curve will help in the design of the tank size for the effluent treatment plant (6.3 Effluent Plant). It also shows that there is quite a wide distribution, showing that the water usage in the wash bay is not constant and varies substantially. An interesting fact is that the distribution is not related to production, meaning that as production increases the water used in the wash bay does not necessarily increase proportionally as one would expect. The few explanations for this could be that

- Employees, who are cleaning, are not trained properly on how to clean the items used. This was proved to be correct by observing the way in which a 5 litre bottle was being washed on one occasion. The hose was put into the bottle and allowed to run until there was clear water coming out the top and then held upside down with the hose inside to rinse it out. This whole process took more than a minute and an astonishing 27 litres of water was used.
- Taps are left open. This is the case as on more than one occasion it was found that the taps were running when there was nobody in the wash bay, on one occasion the tap was even left on overnight.
- No washing schedule. This means that a large number of unwashed items lie around the wash bay and every now and then one of the employees decides to wash everything, causing a large quantity of water is used on those days.

It is obvious that it is not just one of these explanations, but a combination of all three and possibly more will contribute to this erratic flow variation and also to the large water wastage.

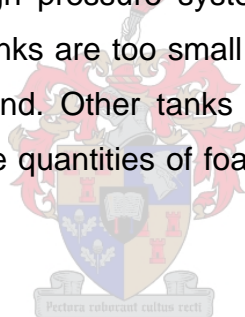
Proper procedures are to be drawn up and training done to reduce the amount of water used to clean containers at the wash bay. A high pressure nozzle with automatic shut off is also to be fitted to all the hose pipes.

There are so many different tanks, containers, buckets, bottles, drums and other apparatus to clean, that it would be ideal to have a single person cleaning

everything. This will mean that the specific person is responsible for the amount of water used to clean all the abovementioned items. The responsibility will lead to better results. This approach will also save time because instead of trying to train and monitor more than 50 employees, only one (and a back-up) has to be trained and (hopefully only initially) monitored.

### **6.1.2 Process Effluent Excluding Wash Bay**

It was also found that 4.03 kl per month is being used to clean tanks. This is an acceptable water usage figure for tank cleaning which possibly has to do with the fact that only two employees clean tanks. One cleans the peroxide and perm lotion tanks while the other cleans the shampoo and main tanks (all the other tanks). The employee who cleans the shampoo and main tanks uses a high pressure system for some of the tanks. The high pressure system is not used for all the tanks because some of the smaller tanks are too small to use the high pressure system and have to be washed by hand. Other tanks like those in which shampoo is manufactured would cause large quantities of foam if a high pressure system was used to clean them.



### **6.1.3 Ion Exchange Unit**

Deionised water is used in the peroxide which needs high quality water. The rinse water from the ion exchange unit is sent to a separate tank where it is used in products which do not need such high purity water but needs better quality water than the municipal feed. It is only the regeneration water which is sent to the effluent stream and the amount of regeneration water cannot be minimised as it is inherent in the ion exchange unit.

This still leaves a large amount of water being used for domestic purposes.

#### 6.1.4 Domestic Water

There are many reasons why domestic water usage is so high. Some of which are:

- There are almost 50 employees who use the toilets at least twice a day,
- There are almost 50 employees who wash their hands at least three times a day and often leave the taps open overnight,
- There are visitors who use the toilets and wash their hands,
- Water is used for beverages on a continuous basis,
- Water is used to wash the floors in the offices,
- The garden is watered at least once a week,
- Taps are leaking,
- Water is used in the laboratory, and
- Water is used for other reasons which have not been mentioned here.

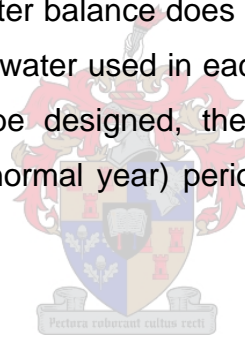
These reasons are all necessary for the effective operation of the company and for some of them the water usage cannot be improved, but there are many ways in which to decrease the amount of water used, some of which are:

- Put urinals in the men's ablution facilities.
- Install water saving toilets when new ones are needed but for now, put a brick in each toilet to decrease the amount of water used for each flush.
- Put taps in the factory ablutions where it is necessary to hold the tap down in order to get water out – This will decrease the amount of water used and stop water from being left open overnight.
- Recycled water can eventually be used to water the gardens once the effluent treatment plant is operational.
- All taps are to be checked for leaks, fixed and included in the periodic maintenance schedule.

### 6.1.5 Comments

Besides the cost of the incoming water, the cost of the water going to the municipal sewer should also be considered even though at the moment this is not paid for. It is , however, a matter of time before the municipality finds out and then the penalties could be great. Therefore this has to be dealt with immediately. Currently it would cost R706 per month to send the water to the municipal sewer calculated from Ekurhuleni Metropolitan Municipality (2003b).

The water balance was only performed over the months from May to August 2004. The water balance is not a true reflection of the average water usage through the year because as can be seen from Figure 6-1, more water is used over October and November, while less is used over December because the factory is closed for half the month. Although the water balance does not accurately depict the average water usage, the percentage of water used in each section is still accurate. Before a water treatment plant can be designed, the effluent water will have to be measured over a whole year (normal year) period, as the flow rates would differ throughout the year.



## 6.2 Effluent

The effluent generated from the manufacturing area is not suitable for municipal waste water treatment works because it consists of:

- Surfactants (incl. Sodium Lauryl Sulphate, Sodium Laureth Sulphate, etc.) which are large organic molecules normally composed of a strongly hydrophobic group combined with a strongly hydrophilic group. Surfactants cause foaming in wastewater treatment plants and in the surface water into which effluent is discharged (Metcalf & Eddy, 2003)
- Peroxides which kill the bacteria at the treatment plant,
- Acids which change the pH of the water, also killing bacteria, and
-

- Suspended solids from cleaning the floors and residue from in the tanks.

The above products are used in production and cause the test results to be outside the allowable limits. The laboratory test results can be seen Appendix E.

Appendix F shows the acceptable discharge limits to the municipal sewer as well as the results obtained from the laboratory test of the effluent. Table 6-3 gives a summary of the acceptable discharge limits showing only the results which are above or close to the limits and those which continuously and could be outside the limits from time to time.

Table 6-3: Summary of discharge limits

Determinants	Upper limits of concentrations	Actual tested results
pH at 25°C	6.0 - 10,0 (Upper and lower limits)	8.4
Substances not in solution (including fat, oil, grease, waxes and like substances) and where the volume of effluent discharged per month does not exceed 10 000 kl	1000 mg/l	900
Fat, oil grease, waxes and like substances soluble in petroleum ether	500 mg/l	417
Non-organic solids in suspension	100 mg/l	144 mg/l
Chemical oxygen demand (COD)	5000 mg/l	6715 mg/l

From Table 6-3 it can be seen that only the suspended solids and COD are above the upper limit concentration. Substances not in solution as well as fat, oil, grease, etc. are close to the upper limit concentration. pH would change constantly due to the large amount of acids and alkalis used to adjust the pH of the products and due to the high and low pH products (for example, perms have high pH's and peroxides have low pH's) which are produced.

For this reason it would be advantageous to have a waste water pre-treatment plant before water is released into the municipal treatment works. If the water is



treated successfully, it can also be recycled for cleaning purposes. If the water treatment is successful enough (ie. the water meets product specification), the water can be recycled to be deionised and used in the product, if this is going to be any more of a financial burden it would not be financially viable or practical.

After system optimisation and training is done to reduce water waste to a better level, a treatment plant is to be designed. The design cannot be completed as yet because sizing would be a problem. The water from the treatment plant is to be recycled and used in the wash bay. Its quality does not have to be very high as it is going to be used for cleaning. Recycling water to be used in the product is not even considered as there would have to be a large number of quality checks, laboratory tests and potential problems that it would be more of a financial and time consuming burden than a gain.

### **6.2.1 Necessary Information**

This is not an effluent system design to be implemented but a basic guide as to what has to be looked at and what information has to be gathered before a final design can be initiated.

- The effluent has to be tested over a period of time (preferably over the period of three months or more, not just a few days, in order to get a good idea as to the averages and peaks.
- Laboratory tests have to be done to determine the sedimentation rates of the particles in the effluent.
- Due to the complexity of the effluent i.e. the large number of varying chemicals and quantities, a laboratory scale pilot plant for the different processes has to be constructed and evaluated before further design work can continue.

Due to financial concerns the effluent treatment system is to be done in stages over a period of time.

### 6.2.2 System

For effluent discharged to the environment, the allowable pH usually varies between 6.5 and 8.5.

No biological treatment is going to be considered as it is often very sensitive and problematic. There are also too many chemicals which would affect the bacterial equilibrium or even kill all bacteria, even in small dosages.

## 6.3 Effluent Plant

The best type of effluent treatment plant would be only a few tanks in series due to space constraints. Fluids movement will mostly be gone by gravity flow as this reduces costs and is possible due to slope of the land around the factory buildings and the location of the factory buildings on the premises.

### 6.3.1 Physical Unit Operations

#### 6.3.1.1 Screening

##### *6.3.1.1.1 Background (Metcalf & Eddy, 2003)*

Two general types of screens, course screens and fine screens, are used in preliminary treatment of water.

**Course screens** consisting of parallel bars or rods (“bar rack”) or grating (clear openings ranging from 6 to 150 mm) are used to protect pumps, valves, pipelines and other equipment from damage or clogging from rags or large objects. Industrial

effluent treatment plants may or may not need them, depending on the character of the waste.

**Fine screens** consisting of wire mesh, wire cloth or perforated plates (clear openings less than 6 mm) are used in a broad spectrum of applications, including preliminary treatment, primary treatment and the treatment of combined sewer overflows.

**Micro screens** generally have openings of less than 50  $\mu\text{m}$  and are used in removing fine solids from treated effluents.

#### **6.3.1.1.2 Recommendation**

A grid over the effluent drain will serve as the coarse screen.

Because the waste is mostly water and product or raw materials, there is very little chance that there are going to be any large objects in the waste stream. If accidentally a large object does enter the stream, there are no pumps in the line which could get damaged and the large objects will then be caught by the fine screens.

The use of fine screens is necessary because there is particulate dirt in the waste stream (from floor mopping, dirty containers etc). The screens do not have to be extremely fine, just fine enough (to be determined) to remove the larger particles. The rest of the smaller particles solids will settle in the first tank.

### 6.3.1.2 Flow Equalisation

#### 6.3.1.2.1 Background (*Metcalf & Eddy, 2003*)

Flow equalisation is a method used to overcome the operational problems caused by flow rate variations, to improve the performance of the downstream processes and to reduce the size and cost of downstream treatment facilities.

It is simply the damping of low rate variations to achieve a constant or nearly constant flow rate and can be applied in a number of different ways depending on the characteristics of the collection system.

The principal benefits of flow equalisation are:

- Biological treatment is enhanced – shock loadings are eliminated or can be minimized, inhibiting substances can be diluted and pH can be stabilized.
- Effluent quality and thickening performance of secondary sedimentation tanks following biological treatment is improved through improved consistency in solids loading.
- Effluent filtration surface area requirements are reduced. Filter performance is improved and more uniform filter-backwash cycles are possible by lower hydraulic loading.
- In chemical treatment, damping the mass loading improves chemical feed control and process reliability

Disadvantages:

- Relatively large land areas are needed.
- The equalisation facility may have to be covered for odour control in residential areas.
- Additional operation and maintenance is required.

### **6.3.1.2.2 Recommendation**

There is no effluent generation during the night and weekends as the company is only operational during the day (7:45 – 16:45) on weekdays. This means that there is a large variation in effluent flow rate between day and night. Because the effluent is mostly produced from batch washing, there are small variations in the effluent flow rate during the day. This along with the fact that the downstream treatment facility will be smaller and cheaper makes the use of a flow equalisation system a good idea.

This will also neutralise any high or low pH, peroxide and ammonia peaks which will mean that less treatment has to be performed downstream.

### **6.3.1.3 Mixing**

#### **6.3.1.3.1 Background (Metcalf & Eddy, 2003)**

Mixing is important for:

- Mixing of one substance completely with another,
- Blending of miscible liquids,
- Flocculation of wastewater particles,
- Continuous mixing of liquid suspensions, and
- Heat transfer.

Most mixing operations in effluent treatment can be categorised as continuous-rapid (less than 30 second bursts at intervals) or continuous.

#### **Continuous-Rapid Mixing**

This is used often where one substance is to be mixed with another. The principal applications are:

- The blending of chemicals,
- The blending of miscible liquids, and

- The addition of chemicals to sludge and biosolids to improve dewatering characteristics.

### **Continuous Mixing**

This is used where the contents of a reactor or holding tank or basin must be kept in suspension.

#### **6.3.1.3.2 Recommendation**

Continuous-Rapid mixing is the best option, the period between mixing bursts will be sufficient to allow oils to move to the top and be removed through the use of an oil absorption pad and heavy sediment (grit) to the bottom which will be cleaned out periodically but short enough to still mix during any peaks or variations in incoming effluent concentration. To reduce costs this will be done in the flow equalisation tank.

#### **6.3.1.4 Gravity Separation**



##### **6.3.1.4.1 Background (Metcalf & Eddy, 2003)**

The removal of suspended and colloidal material from wastewater by gravity separation is one of the most widely used operations in wastewater treatment. Sedimentation is the separation of suspended particles that are heavier than water, it is used for the removal of grit, total suspended solids (TSS) in primary settling basins, biological floc removal from activated sludge and chemical floc removal when chemical coagulation is used. Most of the time sedimentation is used to clarify the effluent. There are four types of gravitational settling that can occur nl:

- Discrete particle settling
- Flocculent settling
- Hindered (or zone) settling
- Compression settling

#### **6.3.1.5 Grit Removal (Metcalf & Eddy, 2003)**

The removal of grit from effluent can be accomplished in grit chambers or by the centrifugal separation of solids. Grit chambers are designed to remove grit, consisting of sand, gravel and other heavy solid materials that have densities much larger than those of the organic solids in the effluent. Grit chambers normally are located after the bar screens and before primary sedimentation.

Grit chambers are used to:

- Protect moving mechanical equipment from abrasion and abnormal wear
- Reduce formation of heavy deposits in pipelines and channels
- Reduce the frequency of digester cleaning caused by the excessive accumulation of grit.

#### **6.3.1.6 Primary Sedimentation (Metcalf & Eddy, 2003)**

The objective of treatment by sedimentation is to remove readily settleable solids and floating material, thus reducing the suspended solids content. Efficiently designed and operated primary sedimentation tanks should remove 50 – 70 % of the suspended solids and 25 – 40 % BOD.

##### **6.3.1.6.1 Recommendation**

A grit chamber is necessary because there will be grit from washing the floors and dirty drums which would not be removed by a fine screen. A sedimentation tank would be a good idea. Because there will be both discrete particle settling as well as flocculent settling, the design of the sedimentation tank can only be done after some laboratory tests.

To save on space, capital and operating costs, the grit chamber and equalisation tank can be combined. It should be done in such a fashion that if a little grit gets through when there is a large peak, it will still settle in the sedimentation tank.

### **6.3.1.7 High Rate Clarification**

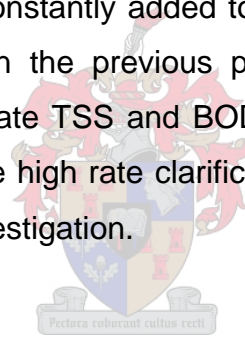
#### **6.3.1.7.1 Background (Metcalf & Eddy, 2003)**

High rate clarification involves physical and chemical treatment and utilizes special flocculation and sedimentation systems to achieve rapid settling. Advantages of high rate clarification are:

- Units are compact,
- Start-up times are rapid, and
- A highly clarified effluent is produced.

#### **6.3.1.7.2 Recommendation**

Because extra chemicals are constantly added to the water, high rate clarification would be more expensive than the previous processes. If it is not absolutely necessary i.e. if there is adequate TSS and BOD removal (to municipal limits) in the sedimentation tank, then the high rate clarification should be ignored. This will be found from the pilot plant investigation.



### **6.3.1.8 Flotation**

#### **6.3.1.8.1 Background (Metcalf & Eddy, 2003)**

Flotation is a unit operation used to separate and remove finely divided suspended solids and particles with densities close to that of water. Separation is brought about by introducing fine gas bubbles (usually air) into the liquid phase. The bubbles attach to the particulate matter and the buoyant force of the combined gas bubble and particle is great enough to cause the particle to rise to the surface. Both particles with a high and lower density than that of water can be made to rise. The principal advantage that flotation has over sedimentation is that very small or light particles that settle slowly, can be removed more completely and quicker. The



degree of removal can be enhanced by adding certain chemicals such as flocculants, depressants, etc.

#### **6.3.1.8.2 Recommendation**

Due to space and cost problems, having both the sedimentation and flotation processes does not seem practical. Thus, one of the two should be chosen. Even though flotation removes smaller and lighter particles quicker than sedimentation, it is more expensive to operate than a sedimentation tank as there has to be an air pump, a special skimming device and special chemicals.



## 6.3.2 Chemical Unit Operations

### 6.3.2.1 Background (Metcalf & Eddy, 2003)

There are many disadvantages to using chemical unit operation

- It is an additive process, as a result there is usually a net increase in TDS. This is a significant factor if the water is to be reused.
- In precipitation there is a large volume of sludge to be handled, treated and disposed of.
- The cost of chemicals can be quite high.

Due to these disadvantages, as little chemicals will be used as possible.

Chemical unit operations which aren't discussed are:

- Advanced oxidation processes,
- Chemical coagulation,
- Chemical scale control – Used to prevent calcium carbonate and sulphate formation. Only needed if scale is a problem or if nanofiltration, reverse osmosis or electrodialysis is used.
- Stabilisation – Used after reverse osmosis demineralisation to adjust pH and calcium carbonate concentration to prevent metallic. No reverse osmosis unit is planned and sufficient minerals should exist to prevent metallic corrosion.

### 6.3.2.2 Chemical Neutralisation

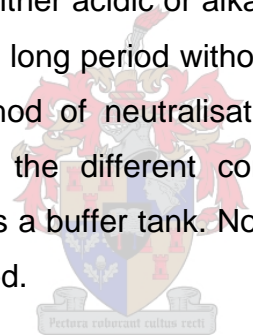
#### 6.3.2.2.1 Background (Metcalf & Eddy, 2003)

Neutralisation is the removal of excess acidity or alkalinity by treatment with a chemical of the opposite composition. There is often a need for pH-adjustment in water treatment facilities. Because a number of chemicals that can be used are

available, the choice will depend on the suitability of a given chemical for a particular application and prevailing economics.

#### **6.3.2.2.2 Recommendation**

Chemical neutralisation will have to be used because there is a vast number of chemicals used with a very wide range of pH's from very basic to very acidic. The chemicals to be used would be sodium hydroxide (for acidic effluent) and hydrochloric acid (for basic effluent) because these are already used, thus no new chemicals would have to be purchased. These are also strong acids and bases therefore not a lot would have to be used. Because both acidic and basic chemicals are used, in most cases the two will neutralise each other and there will be no need for further neutralisation. The chemical neutralisation will only be necessary if there is a peak of either acidic or alkali effluent coming in or if more of one (acid or base) come in for a long period without any of the other. An online pH meter would be the best method of neutralisation but the pH only has to be controlled at intervals due to the different compositions of effluent and the equalisation tank also serving as a buffer tank. No pH has to be measured at night as no new effluent is being added.



#### **6.3.2.3 Chemical Oxidation**

##### **6.3.2.3.1 Background (Metcalf & Eddy, 2003)**

Chemical oxidation in water treatment typically involves the use of oxidizing agents such as ozone, hydrogen peroxide, permanganate, chloride dioxide, chlorine and oxygen to change the chemical composition of a compound or group of compounds. Chemical oxidation is used to:

- Reduce the concentration of residual organics,
- Control odours,
- Remove ammonia,
- Reduce the bacterial and viral content of wastewaters,

- Improve the treatability of non-biodegradable organic compounds,
- Eliminate the inhibitory effects of certain organic and inorganic compounds to microbial growth, and
- Reduce or eliminate the toxicity of certain organic and inorganic compounds to microbial growth and aquatic flora.

#### **6.3.2.3.2 Recommendation**

Hydrogen peroxide would be used for chemical oxidation as it is already a stock item. There would be very small amounts of hydrogen peroxide in the effluent stream, but in most cases not enough.

The hydrogen peroxide is bought in 35 kg drums and an average of two to three are used per day. These are not cleaned once empty, simply stored to be returned for deposit. There is always still a small amount of peroxide in the drums therefore by rinsing these drums with a little water, one would not have to add as much hydrogen peroxide to the effluent. This would also reduce the risk of an incident occurring with the peroxide remaining in the drums. This rinse water is then simply going to be recycled back to the wash bay from the effluent plant and will therefore not have any impact on the total amount of water used.

#### **6.3.2.4 Chemical Precipitation**

##### **6.3.2.4.1 Background (Metcalf & Eddy, 2003)**

Chemical precipitation involves the addition of chemicals to change the physical state of dissolved and suspended solids and facilitate their removal by sedimentation. Chemical precipitation is used:

- as a means of improving the performance of primary settling facilities,
- as a basic step in the independent physical-chemical treatment of wastewater,
- for the removal of phosphorus, and

- for the removal of heavy metals.

The principal design considerations related to the use of chemical precipitation involves the analysis and design of the necessary sludge processing facilities and the selection and design of the chemical storage, dosage, feeding, piping and control systems.

A number of chemicals are used as precipitants, the degree of clarification obtained depends on the quantity of chemicals used and the care with which the process is controlled. It is possible to obtain a clear effluent, removing 80 – 90 % of the TSS including some colloidal particles, 50 – 80 % of the BOD and 80 – 90 % of the bacteria; significantly better than tanks without chemicals. The most common chemicals used are: alum, aluminium chloride, calcium hydroxide (lime), ferric chloride, ferric sulphate, ferrous sulphate and sodium aluminate.

#### **6.3.2.4.2 Recommendation**

Chemical precipitation will be used in the primary sedimentation tank to improve performance if necessary. The necessity of chemical precipitation and the chemical to be used will depend on the analysis and the amount to be used will depend on the pilot plant results. What is going to be done with the large volume of sludge produced will have to be carefully considered.

#### **6.3.3 Other Important factors**

Table 6-4 is a table of important factors as found in Metcalf and Eddy, 2003. These are important factors to be considered for the design of the effluent plant. As can be seen, a lot of these factors have to be found from a pilot plant investigation.

Table 6-4: Important factors in effluent plant design (Metcalf and Eddy, 2003)

	Factor	Company parameters
1	<b>Process Applicability – Most important</b>	Past experience, published data and especially pilot plant study.
2	Applicable flow range	300 – 5000 L/day (See 6.1 Water balance)
3	Applicable flow variation	(See 6.1 Water balance)
4	Incoming effluent characteristics	See Appendix E – more tests are to be done.
5	Inhibiting and unaffected constituents	To be determined
6	Climatic Constraints	Winters can become too cold and summers too hot, insulation or some other form of temperature control will have to be considered
7	Process sizing based on reaction kinetics or process loading criteria	To be determined
8	Process sizing based on mass transfer rates or process loading criteria	To be determined
9	Performance	To be determined (Municipal document)
10	Treatment residuals	Obtained from pilot plant operation
11	Sludge processing	The type of sludge is to be obtained from pilot plant operation
12	Environmental constraints	For operational health as well as the surrounding community, the process must be fairly odour-free. Noise won't be a problem.
13	Chemical requirements	To be determined
14	Energy requirements	Very low energy requirements as a gravity flow system is suggested without any mechanical equipment. This is possible due to the gradient of the buildings location
15	Other resource requirements	To be determined
16	Personnel requirements	Due to the fairly simple design, there won't need to be any permanent operator (only daily checks will have to be done), only a little training will be necessary and the skills are readily available
17	Operating and maintenance requirements	Chemical requirements (See no 13) and mechanical failure
18	Ancillary processes	None
19	Reliability	Due to the simplicity, the plant should be reliable. Shock loading shouldn't cause a problem as it would be diluted in the first tank.
20	Complexity	Very Simple to operate both under operating and emergency conditions
21	Compatibility	The plant will be over designed to compensate for an increase in effluent as the company expands. Plant expansion is easily accomplished by the addition of more tanks.
22	Adaptability	As with no 21
23	Economic life-cycle analysis	To be determined
24	Land Availability	Due to the small flow rates of the effluent, the tanks can be fairly small (with still enough room for growth) and shouldn't take up too much space as they can be buried under ground and the space can be used as parking.
25	Potential Problems	Mechanical failure

## 6.4 Summary

From this chapter it was found that the water use in the wash bay is too high and some practical ways of decreasing the water usage are presented. It is found that the water use for domestic purposes is excessive and some practical ways of decreasing the use are also given.

Different ways of treating the effluent are discussed and it has been decided that the best setup would be two tanks in series as shown in Figure 6-4.

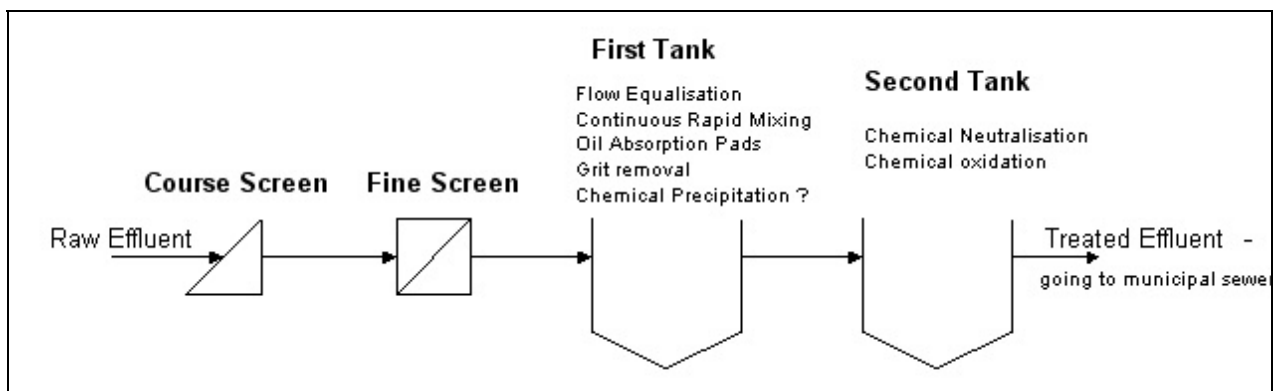


Figure 6-4: Proposed effluent plant flow diagram

Figure 6-4 shows a diagram of the proposed effluent plant, the tanks consist of:

- Tank 1: Flow Equalisation: For flow equalisation, grit chamber, removal of oil. At night the separation will be very good because there is no effluent coming in therefore mixing can be stopped.
- Tank 2: Chemical Neutralisation and Oxidation Tank: To decrease costs both of these will be done in the same tank.

Depending on the pilot plant design an extra tank can be used to separate the different processes. This is only a preliminary design and very much dependant on the pilot plant investigation.

## 7. Management

Now that the three systems have been discussed and integrated, and practical examples have been given as to how to improve the company, the management of the company is to be discussed because in the end, it is management that determines whether the system is to succeed or not.

### 7.1 Management Commitment

All three systems discussed in this text require management commitment before they have any chance of survival let alone being effective and efficient. This may simply seem like a formality, but in fact is more difficult than it seems.

Management will most of the time be more than willing to say that they are committed to the management systems and are more than happy to sign the various policies but when it comes to giving what is necessary i.e.: resources, capital and time, this is where the true commitment is revealed.

Management at AIC is no different. There are often excuses as to why time, money or resources cannot be given for the management systems (even for inexpensive resources) and this shows how committed or non-committed management really is. Often management does not distinctly say no but finds other ways of getting out of giving up precious time, money and resources for example lengthy delays in decisions or supplying of funds, not agreeing to necessary items needed for the management system, or simply ignoring any requests. Anything to do with the management system which does not directly better production or profits always takes last place on the priority list even though it would save money in the near future.

### 7.2 Human Error



Everything in the organisation can be perfect (temperatures, pressures, analyser conditions, etc,) but things can still go wrong through human error due to tiredness, lack of concentration etc causing problems to health and safety, quality and the environment. Probably the most significant cause of human error is motivation. The previously mentioned influences which cause human error would be avoided if the employee was highly motivated and it is management's responsibility to keep employees highly motivated. The following is a list of some important factors affecting motivation (Russell, 2004):

- Lack of money – Lack of money for life essentials will have a very negative impact on the quality of work delivered.
- Training – If an employee is not trained properly s/he cannot be expected to do his/her job correctly
- Lack of recognition – If a person is not shown recognition they start to feel unappreciated and their quality of work may be affected.

There are many more factors affecting motivation which should not be ignored when trying to motivate employees, each situation should be considered differently.

Through motivating employees, human error can be reduced and minimised which would already reduce a lot of problems to do with quality especially. Motivation would also improve the feeling in the organisation as motivated people are normally happier, friendlier and more focussed especially when their inspiration to better their position finally pays off and they see positive results.

## **7.3 Business Ethics**

All over the media, especially the television, it has been shown that to be successful in business one has to be ruthless and almost without ethics. This is far from reality as most businesses which are run in this way do not last long due to their bad name. The truth is that in order to run a sustainable business, one requires good business ethics (van Aardt et al, 2000).

In the past businesses were only interested in profit and a policy of absolute secrecy regarding their operations was pursued. Today however it is being realised that the business venture is part of the community and that the survival of the business is sometimes closely linked with that of the community.

It is the responsibility not only of the employer but also management to instil a good business code of ethics. Business ethics are the principles of conduct which guide decision making and conduct. These principles are needed even before implementation of the integrated management system begins. If good business ethics are incorporated into the development of the integrated management system, they will compliment each other. A good business code of ethics will provide a basis on which policies can be devised to guide daily behaviour and decisions (van Aardt et al, 2000).

Personal ethics of the employer and management, listed below, would have a direct impact on employees, customers, competitors, interested parties and business decisions (van Aardt et al, 2000). These are:

- **Honesty** – Dishonesty leads to distrust and suspicion, no one wants to do business with a company when these traits are present.
- **Reliability** – This means that people can depend on the employer and management. Without this people do not know where they stand, they don't know if you're going to deliver what you promised when you promised it.
- **Fairness** – No person should be discriminated against. This affects labour practices, personnel relations, promotion policies and remuneration practices.

The day-to-day operations of the venture also give rise to ethical dimensions which have to be considered. These relate to products, services, advertising and personnel relations amongst other (van Aardt et al, 2000). These are:

- **Safety of Products and Services** – This relates directly to the QMS side of the integrated management system

- The quality and price of products and services – This also related to the QMS side of the integrated management system but also has to do with value for money.
- Advertising – It is very easy and tempting to provide false information of the product or even the competitors' product to gain an edge but this is ethically wrong and would soon be found out, often first hand by the customers after which they would never trust the companies advertising again.
- After-sales service – The organisation should aim to include good after-sales service.
- Dealing with employees – This relates to the integrated management system with regard to employees environment and safety. Fair wages should be paid, health-care facilities should be offered. Personal ethics of the employee should also be considered.

## 7.4 Social Responsibilities

Social responsibilities are directly linked to business ethics, in fact it is quite difficult to tell see the difference. Business ethics are the morals that the organisation exhibits whereas social responsibility is the obligation of an organisation to protect and better the society in which it operates (Van Aardt et al, 2000). Moral business ethics could guide the business in addressing the social responsibilities. There are various areas in which the organisation could exercise it's responsibilities, these are:

- Environment – This is done through the EMS section of the integrated management system
- Customers – Customers have four rights, these are, the right to:
  - Safe products,
  - Be informed of aspects of the products or services,
  - Be heard if they have a complaint, and
  - To choose what to buy.

All of these rights are covered in the QMS part of the integrated management system

- Employees – All aspects of the integrated management system consider the employee and this has been discussed under ethics (7.3 Business Ethics)
- Investors – Maintaining a proper accounting system, providing information concerning the financial situation of the business, reinvesting profit would address these responsibilities. Actions such as withholding financial information, accepting bribes, cover-ups, etc. are all detrimental to the relationship with the investor and also bad business ethics.
- General welfare of the community – Involvement in health and education, contributing to charities are examples of good social responsibilities.

## 7.5 Chapter Summary

One of the fundamental foundations to an effective and efficient management system is management commitment and the management at AIC are not as committed as they ought to be. Before the commencement of implementation they will have to decide what is important to the company.

Employees should be motivated through fair pay, training and recognition as this will reduce human error and also improve the general feeling in the organisation.

Business ethics and social responsibilities are of vital importance to a business if it wants to be sustainable, the management system will be greatly enhanced if these moral ethics and responsibilities are shown by management and are incorporated into the integrated management system.

## 8. Conclusions and Recommendations

### 8.1 Conclusions

- A brief background of the organisation is given in order to determine the current (pre-implementation) status of the company.
- The Environmental management system (ISO 14000), Quality management system (ISO 9000) and Operational Health and Safety were discussed as well as how each is implemented independently. A gap analysis of each of the management systems was carried out and where the systems overlap or have common goals, these systems were integrated to form the framework of an IMS (No actual documented system is included here).
- The different functional departments of the organisation nl. inventory, production and administration were investigated and suggestions on how to improve these are documented.
- The water use of the organisation was investigated and it is found that the water use in the wash bay is too high and some practical ways of decreasing the water use are given, it is also found that the water use for domestic purposes is far too high and some practical ways of decreasing the use here are also given.
- Different ways of treating the effluent is discussed and it has been decided that the best setup would be two to three tanks in series including a flow equalisation tank and a chemical neutralisation and oxidation tank. Depending on the pilot plant investigation an extra tank can be used to improve the water quality.

- One of the fundamental foundations to an effective and efficient management system is management commitment and the management at AIC are not as committed as they say they are.
- Employees should be motivated through fair pay, training and recognition as this will reduce human error and also improve the general feeling in the organisation.
- Business ethics and social responsibilities are of vital importance to a business if it wants to be sustainable, the management system will be greatly enhanced if these moral ethics and responsibilities are shown by management and are incorporated into the integrated management system.

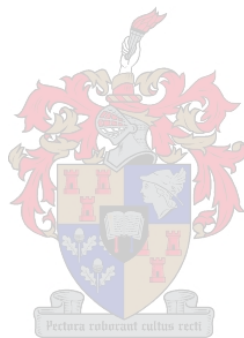
## 8.2 Recommendations

The suggestions for the different functional departments are to be carried out first as these are the most obvious and currently cause the most problems. If the suggestion which is carried out is somehow linked to a section of any of the systems, these sections can be completed first. For example before the suggestions are carried out they should be put on the aspect register and be labelled as high priority. This completes the aspect identification section (Section 4.3.5 Aspect Identification) for the integrated management system.

Once these problems are fixed, the gap analysis of each system is to be looked at and implemented. Obviously the sections which are the same or overlap only need to be done once or need to be modified to include the sections of the systems which overlap so that these sections only need to be completed once.

Training seems to be the major problem in the organisation at present and once the appropriate sections of the integrated management system have been

completed, training should become part of the companies' routine. This would solve a lot of the problems in the company.



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# Appendices

- Appendix A. Digital Photos of Company
- Appendix B. Acts to be considered
- Appendix C. OH&S Gap Analysis
- Appendix D. Hazardous Chemicals Analysis
- Appendix E. Effluent Water Test Results
- Appendix F. Acceptable Discharge Limits



## Appendix A. Digital Photos of Company



Figure 9-1: Photos of the chemical store  
(Before implementation)



Figure 9-2: Photos of the raw material drum store  
(Before implementation)



Figure 9-3: Photo of perfume and colour store  
(During implementation)



Figure 9-4: Photos of the empties store  
(During implementation)



a



b



c



d



Figure 9-5: Photos of the a) shampoo, b) peroxide, c) general and d) alcohol based products production areas  
(During implementation)



Figure 9-6: Photos of the filling and packing area  
(During implementation)



Figure 9-7: Photo of the finished product bulk store  
(During implementation)





Figure 9-8: Photo of the finished goods holding area  
(Before implementation)

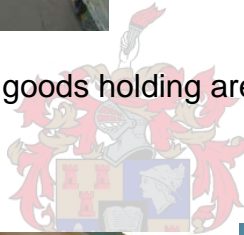
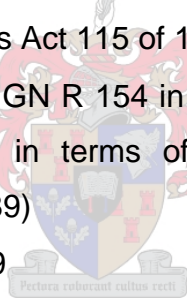


Figure 9-9: Photos of the finished goods store  
(Before implementation)



## Appendix B. Acts to be considered

- The National Environmental Management Act (NEMA) 107 of 1998
- The Environment Conservation Act 73 of 1989
- The Atmospheric Pollution Prevention Act 45 of 1965
- The Hazardous Substances Act 15 of 1973
- The National Water Act 36 of 1998
- The Water Services Act 108 of 1997
- The Regulations Relating to Compulsory National Standards and Measures to Conserve Water GN R509 in GG 22355 of 8 June 2001
- The National Road Traffic Act 93 of 1996
- The Occupational Health and Safety Act 85 of 1993
- Foodstuffs, Cosmetics and Disinfectants Act 54 of 1972
- National Veld and Forest Fire Act 101 of 1998
- The Hazardous Substances Act 115 of 1973
- Noise Control Regulations GN R 154 in Government Gazette No. 13717 of 10 January 1992 (made in terms of Section 25 of the Environment Conservation Act 73 of 1989)
- Road Traffic Act 29 of 1989



## Appendix C. OH&S Gap Analysis

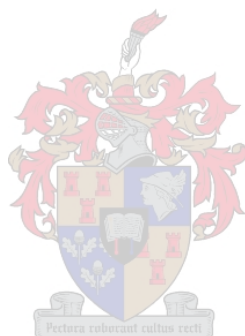
Only those provisions in the act and regulations which are relevant to the organisation are considered.

### Act

Table 9-1: OH&S Gap Analysis for the Act

Ref.	Description	In place?	Partial description
7	<b>Health and Safety Policy</b>	No	
8	The working environment is safe and without risk to the health of employees	Partial	See Regulations gap analysis
9	All persons other than employees who may be directly affected by the companies activities is not exposed to hazards of health and safety	Partial	See Regulations gap analysis
10(1)	Any article manufactured is safe and without risk to health when properly used and complies with prescribed requirements	Yes	
10(2)	It is ensured that any article erected or installed for use at work is not unsafe in the manner that it was erected or installed when used properly	No	
10(3)	Any product manufactured for use at work is safe when used properly and that information is available with regard to the use of the substance, risks, safe conditions and procedures to be followed	No	Products produced are safe but there is no documented information
13(a)	<b>Every employee is conversant with the hazards to health and safety attached to any work s/he may perform, any substance or article which s/he has to handle and any machinery which s/he has to handle</b>	No	
13(b)	Inform HSR beforehand of inspections, investigations or formal inquiries of which s/he has been notified by an inspector	No	
13(c)	Inform HSR as soon as possible of an incident in the workplace for which the HSR has been designated	No	

15	No person may intentionally or recklessly interfere with, damage or misuse anything which is provided in the interest of health and safety	No	Not in any procedures as yet
17(1)	<b>A health and safety representative is designated in writing</b>	No	HSR is to be designated



## Regulations

Table 9-2: OH&S Gap Analysis for the Regulations

Number	Description	In place?	Partial description
<b>1.</b>	<b>General Administrative Regulations</b>		
3	Copy of the act	Yes	
<b>7(1)</b>	<b>MSDS's for products</b>	No	Not known which products require MSDS's. It can only be the perm and peroxide, this is to be looked into
7(2)	MSDS's for all hazardous chemicals	Partial	MSDS's in the ISO 11014 form are not available for all hazardous chemicals as it is not know whether some of the chemicals without MSDS's are hazardous or not. MSDS's are available for most chemicals.
<b>8</b>	<b>Recording of Incidents</b>	Yes	
10(1)	Employees not to be under the influence at work	No	No breathalyser is available to test alcohol content
10(2)	No employee may be in possession of an intoxicating substance	Yes	Disciplinary Procedure (P001)
10(3)	Employees taking medication may not be on the premises if their medication causes them to pose a threat	Yes	Disciplinary Procedure (P001)
11	Admittance of persons regulations	Yes	
<b>2.</b>	<b>General Safety Regulations</b>		
<b>2(1)</b>	<b>Evaluation and minimisation of risk</b>	Partial	In the process of changing the factory in order to minimise risk
2(2)	Issue of safety equipment	Yes	
2(4)	Safety equipment not to be removed from the workplace	Yes	Disciplinary Procedure (P001)
<b>2(5)</b>	<b>Safety equipment training</b>	No	Formal training of use, maintenance and limitations of safety equipment has not yet been done.
2(6)	Employees not permitted to work without required safety equipment	Partial	Only for highly hazardous chemicals (thioglycolic acid) are employees forced to wear the required safety equipment, in all other

			circumstances there is no control over whether employees wear safety equipment or not.
<b>3(1)</b>	<b>Prompt First Aid</b>	Yes	
<b>3(2)</b>	<b>First Aid Box</b>	Yes	
<b>3(4)</b>	<b>At least one employee with a valid first aid certificate is available during working hours</b>	Yes	
<b>3(5)</b>	<b>Specific training for high risk or toxic substances used in the organisation</b>	No	Specific training still to be done for acids and bases
<b>3(6)</b>	<b>Prominent notice of first aid box location and person in charge</b>	No	
<b>3(8)</b>	<b>Eyewash fountain in place</b>	No	
<b>3(9)</b>	<b>Fast-reacting deluge-shower</b>	No	
4(2)	Flammable liquids are to be used only in rooms specially designed therefore	No	The alcohol room has only three walls, the fourth being open to the atmosphere but if no wind is present, the alcohol fumes could still accumulated.
4(3)	Every room in which flammable liquids are used is to have an intake and outlet ventilation system		
4(7)	Every room in which flammable liquids are used is to have two doors on opposite ends of the room.	Yes	The alcohol has an open side which is just as good as having two doors on either side
4(8)	No form of ignition may be present in a room where flammable liquid is used at all	No	There is an electric board in the room and the plugs are not static free
4(9)(a)	Cotton waste, rags etc are to be removed daily	No	This is not done
4(9)(b)	Only the quantity of flammable liquid necessary for one day is to be present in the room	Yes	
4(9)(c)	Drums are to be tightly closed and when empty, disposed of daily	Yes	
4(9)(d)	The rooms where flammable liquids are used are to be kept clean	No	The room is quite dirty and is not cleaned often
4(10)(c)	Flammable store meets all criteria	Yes	Inspected regularly by approved external inspector
4(11)	Adequate fire fighting equipment available	Yes	
6	Work done from an elevated position is to be done safely	Partial	Formal training has not been done
8	Stacking of articles.	Yes	Articles are not to be stacked as defined in the regulations

9(1)(a)	Employees doing Welding or flame cutting have been properly trained	Yes	
9(1)(b)	Protection is provided	Yes	
9(1)(c)	Leads and electrode holders are insulated	Yes	
9(1)(d)	Workplace partitioned or others warned	No	Work places are not partitioned and others are not warned when welding or flame cutting is to be done.
9(3)	Conditions fulfilled for welding done in wet places, inside metal vessels or in contact with large masses of metal	Yes	
9(4)	Conditions fulfilled for welding, flame cutting, grinding, soldering etc done on sealed vessels or vessels containing flammable or dangerous substances	Yes	
9(5)	Fire precautions taken in places where hot work is done	No	When hot work is done fire precautions aren't considered
13A(1)	Ladders are constructed as in the regulations	Yes	
13A(2)	No ladder is used with defects as given in regulations	Yes	
13A(5)	Precautions against falling objects and sheaths for hand tools	No	No special precautions are taken against falling objects and no hand tool sheaths are used.
13B(1) & (2)	Ramps are constructed in accordance with the regulations	No	The ramps loads have not been calculated and angles have not been considered. Stepping laths haven't been considered
<b>3.</b>	<b>General Machinery Regulations</b>		
2(1)	Person designated to ensure that the provisions of the act and regulations are complied with	Yes	
2(3)	Competent person [2(1)]	Yes	
3(1)(a)	Machinery must be suitable for the purpose used and installed, operated and maintained to prevent hazardous conditions	No	Not all the machinery is used for what it was intended, training is needed. Not all machinery is installed, maintained and esp. operated to prevent hazardous conditions
3(1)(b)	Every dangerous and exposed	No	Not all dangerous and

	machine part within normal reach is safeguarded		exposed machine parts are safeguarded
3(1)(c)	All safety equipment is in good working order and correctly used	No	See 2(5) and 2(6) of 2 General safety regulations.
3(1)(d)	Quality of material and construction used in machinery and safety equipment is suitable	Yes	
4(1)	Operators and users of machinery are aware of dangers and precautionary measures	No	Not all users of machinery have been informed of the dangers and precautionary measures.
4(2)	Users may not leave machinery requiring constant attention unless relieved by a person competent of running the machine.	Yes	
4(3)	Machinery requiring constant attention must be under the supervision of a shiftman	Yes	
4(5)	Precautions taken so that safety threatening machinery is not accidentally be switched on	Yes	
5(1)	Only a competent person may work on or near moving or electrically alive machinery	No	When work is done on moving or electrically alive machinery there is often a person working on or near the machinery who is not competent
5(2)	Precautionary measures are to be taken when working on or near moving or electrically alive machinery to ensure the safety of persons working on or near the machinery	No	Not enough precautions are taken when working on moving or electrically alive machinery.
5(3)	No person working on moving machinery may wear loose fitting clothing or accessories.	No	Employees wear an overcoat supplied by the company but may wear whatever else they like and some do wear loose fitting clothing and/or accessories
6(1)	Machinery to be provided with devices to stop and start machinery and ...(a) and (b)	Partial	The company is in the process of fitting such devices to machines.
6(2)	Positive means will be provided for rendering the controls of machinery inoperative	Yes	
6(3)	Machinery operated by more than one person simultaneously will have a stopping device at each work point	No	For this specific machinery there is only one stopping device and no audible

	and an audible warning device		warning device
7	Reporting of incidents in connection with machinery	No	The procedures are not in place to report such incidents
9(1)	Person designated under 2(1) has a copy of the Act and regulations	Yes	
9(2)(b)	A form (shown in the regulations) is attached to all machinery other than a boiler	No	
9(3)	The above form is explained to employees	No	
<b>4.</b>	<b>Driven Machinery Regulations</b>		
2	Moving and revolving machinery is to be fenced or guarded, if not, it is to be as safe as if it were	No	There is machinery which is not safe and which should be guarded
8(1)	Grinding machines are to be marked with the manufacturers rated speed or spindle speed in rpm		
8(2)	No grinding machine runs at speeds exceeding the design speed		
8(3)	Every grinding wheel is mounted concentrically on the spindle by means of metal flanges		
8(4)	Every grinding machine has an enclosed in a guard.		
8(5)	Every grinding machine has an adjustable work rest		
8(6)	Every grinding machine has a transparent shield for the eyes. Otherwise suitable eyewear is to be worn	No	Some users do not wear eye protection when grinding
8(7)	A notice is up prohibiting others from carrying out or observing grinding work without suitable eye protection	No	
9(1)	Where the operating point of shears, a guillotine or a press is more than 10 mm the machine is provided with a guard or other safety device	No	The guillotine has no guard or safety device, one is to be attached.
9(2)	No guard is necessary if the operating controls require both hands during the working stroke.	No	
11(1)	All dangerous moving parts of a mixing, agitating or similar machine are place beyond the reach of persons by means of covers etc	No	All stirrers and homogenisers are to be enclosed
11(2)	Every mixing, agitating or similar	No	



	machine cannot be set in motion unless the covers etc are in position and will stop if opened.		
12	Every power driven machine which has two or more rollers rotating in opposite directions, less than 75 mm apart, to be guarded for the full length of the in-running side.		
14	Positive displacement type air compressor ( $>8.5\text{m}^3$ air /min) which is not provided with an operating temperature control is to be fitted with a fusible plug fitted close to the outlet.	Not known	
15	The refrigeration unit complies with a safety standard with respect to it's construction, installation, operation and inspection	Not known	
18(1)(a)	The lifting machine has been designed and constructed in accordance with a generally accepted technical standard	No	A technical standard is to be consulted and the lifting machine is to be modified to comply with the technical standard
18(1)(b)	The maximum load of the lifting machine is clearly marked	No	A sign with the maximum load is to be put up
18(2)(a)	The lifting machine has a device capable of holding the maximum load which will automatically prevent the downward movement of the load in the event of a loss of power	Yes	
18(2)(b)	The lifting machine is to have a device which will stop the driving effort when the load attachment has reached it's highest point	Yes	
18(3)	Every chain which forms an integral part of the lifting machine has a safety factor as prescribed by the safety standard to which the machine was manufactured	No	The lifting machine wasn't manufactured according to a safety standard, the chains are to be checked according to a safety standard.
18(5)	The whole installation is thoroughly examined and performance tested in accordance with the safety standard to which the machine was manufactured	No	The safety standard is to be consulted and then examined according to this standard
18(6)	All chains, sheaves, brakes and safety devices are to be checked every six months or less.	No	The six monthly check is to be started and recorded.
18(8)	No person is allowed to be moved on	Yes	

	the lifting machine		
<b>5.</b>	<b>Electrical Machinery Regulations</b>		
2	Safety equipment (insulated stands, trestles, mats etc) is to be provided to persons working with electrical machinery	No	Persons working with electrical machinery are only issued with very basic safety equipment, they are still to be issued with insulated safety equipment.
3	Whenever work is carried out on any electrical machinery which has been disconnected from all sources of electricity but could retain or regain an electric charge, the machinery is to be earthed or discharged by some other means.	No	
6(1)	Every electrical installation and controlling apparatus and protective device must be capable of automatically isolating the power supply in the event of a fault	Yes	
6(2)	No switch, circuit breaker or fuse shall be installed in the neutral conductor of a polyphase AC or three-wire DC current unless arranged to isolate all phase conductors and neutral simultaneously	Yes	
6(3)	Where reasonably practical, switchgear with an interlocking device arranged so that the door or cover cannot be opened unless the switch is off and cannot be switched on unless the door is closed is installed.	No	
6(4)	All controlling apparatus is permanently marked	No	
6(5)	Notices are up on control gear that is switched off for maintenance purposes.	No	
7	Unobstructed space for operating and maintenance of all switchboards is provided.	Yes	
8(1)	No electrical machinery is used in locations where there is a danger of fire or explosion unless the machinery meets the requirements of a safety standard incorporated for this purpose	No	Electrical machinery which has not been checked whether it meets the requirements is used in the alcohol room which could cause a build up of alcohol

			and cause an explosion.
8(2)	Machinery referred to in 8(1) has a certificate from an approved inspector	No	As 8(1) the machinery has not been certified
8(7)	All electric machinery is to be examined and tested at less than 2 year intervals by a competent person and follow 8(8) guidelines	No	This is not being done
9(1)(a)	No portable electric tool (Operating voltage to earth > 50 V) is used unless its' source incorporates an earth leakage protection device which meets the requirements of a safety standard	Partial	All sources of electricity on the premises incorporate an earth leakage protection device but it has not been checked whether it meets the requirements of a safety standard
9(3)	All portable electric devices used are fitted with a switch to allow for easy and safe starting and stopping of the tool.	Yes	
9(4)	All portable electric devices and their flexible cord and plug are kept in a serviceable condition	Yes	
10(1)	Portable electric lights (> 50 V) have the specified requirements	Yes	
10(2)	Lights (as in 10(1)) are only used in wet or damp conditions or when in contact with large masses of metal when its' source incorporates an earth leakage protection device which meets the requirements of a safety standard	Yes	As in 9(1)(a) – Portable electric lights aren't often used especially in the circumstances mentioned
11(1)	The electric fence energiser delivers an impulse to the fence within the specified values	Yes	
11(2)	The fence energiser is constructed to exclude dust and water and is installed in a minimum dust area and an area which is not a fire hazard	Yes	
11(3)	The electric fence energiser which is connected to an electric supply system is done according to requirements	Yes	
11(4)(a)	The fences' earth leakage is more than 2 metres away from any other earth leakage	Yes	
11(4)(b)	The electric wire is smooth and not barbed	Yes	
11(6)(a)	The electric fence which is situated	Yes	

	along a public road is mounted in such a way that persons cannot inadvertently come into contact with it.		
11(6)(b)	Notices warning people of the electric fence are displayed		
13(1)(a)	Roofs, gutters, downpipes etc are earthed	Yes	
13(1)(b)	All accessible metallic parts of electrical machinery which could become alive accidentally are to be protected by an insulating covering or otherwise enclosed or earthed excepting for those reasons stated in the regulations	No	Not all parts of machinery which could accidentally become alive are insulated, enclosed or earthed. This will be a large task and will have to be done over time.
21	All bare conductors are placed to prevent accidental contact and warning notices are displayed	Yes	All bare conductors are taped closed with insulation tape.
<b>6. Electrical Installation Requirements</b>			
3(1)	Every electrical installation is to have a valid certificate of compliance.	No	An accredited person installed the electrical installations but has not yet produced the certificates
4(1)	No electrical installation is installed if not in accordance with a safety standard	No	No safety standard is followed when installing electrical installations
4(2)	All electrical installation work is to be overlooked by an accredited person	No	An accredited person is not always present when an electrical installation is worked on.
6(3)	No electrical installation is connected unless it has been inspected and tested by an accredited person and a certificate of compliance has been issued.	No	Electrical installations are connected without a certificate of compliance being issued. They are inspected and tested by an accredited person.
<b>7. Environmental Regulations for Workplaces</b>			
2(1)	Employees don't work in an area where the time-weighted average dry-bulb temperature is less than 6 °C (over 4 hours) or outside where the actual dry-bulb temperature is less than 6 °C at any time	Yes	
2(4)	Employees don't work in an area where the WBGT index (over 1 hour) exceeds 30.	Yes	

3(1)	All workplaces are lit according to regulations	No	It is not known whether all workplaces are lit according to regulations as there is no light-meter available.
4	Where employees work most of their shift in a room smaller than 100 m <sup>2</sup> the regulations for window sizes are adhered to	Yes	Currently all window regulations are adhered to but there are potential offices where the regulations would not adhere if employees were to spend most of their shift there.
5	Every workplace is ventilated according to the regulations	No	Yes
6(1)	A machine user provides and maintains enough clear and unobstructed space at every machine to enable work to be carried out without danger	No	Training is to be done to ensure that this is carried out
6(2)(a)	At least 2.25 m <sup>2</sup> of effective floor space is available per employee working in an indoor workplace	Yes	
6(2)(b)	An unimpeded workspace for each employee is made available and maintained	Yes	
6(2)(c)	Every indoor workspace is clean, orderly and free of materials, tools and similar things which are not necessary for the work done	Yes	
6(2)(d)	All floors, stairs and passages are in a good state of repair, skid-free and free of obstructions, waste or material	No	Stairs are slippery and need to be made skid free, passages are obstructed and floors are full of waste
6(2)(e)	Roofs and walls of every indoor workplace are sound and leak-free	No	There are walls through which water is coming into the factory
6(2)(g)	A catch platform or net is placed above an entrance or passageway or the area under which work is being performed is fenced off and signed where the possibility exists for persons to be struck by falling objects	No	No training has been performed and work is done without any such precautions
7	Regulations pertaining to noise levels above 85 dB are adhered to	Yes	Although no noise measuring device is available, it is unlikely that the noise levels are above 85 dB at any time.
9(1)(a)	All emergency doors from any room,	Yes	In all practical cases door

	passage or staircase open outwards		open outwards, where emergency doors or not.
9(1)(b)	Every door of rooms where persons may be present shall be kept clear and capable of being quickly and easily opened from inside to ensure quick and easy evacuation.	Yes	All doors from such rooms are kept clear and is capable of opening easily
9(1)(d)	Staircases and steps leading from one floor to another are provided with substantial hand-rails	Yes	
9(1)(e) & (f)	Regulations are adhered to for staircases intended to be used as fire escapes	No	Thus far there are no staircases which are intended to be used as fire escapes, these are to be installed
9(1)(g)	Workplaces are provided with at least two means of exits	Yes	All workplaces are provided with two or more exits
9(2)	An adequate supply of suitable fire-fighting equipment is provided and maintained	Yes	
<b>8. Asbestos Regulations</b>			
<b>Not Applicable</b>			
<b>9. Regulations Concerning the Certificate of Competency</b>			
<b>Not Applicable</b>			
<b>10. Facilities Regulations</b>			
2(1)	Sanitation facilities are provided in accordance with the provisions of the National Building Regulations	Yes	
2(3)(a)	Toilet paper is given to employees	Yes	
2(3)(b)	Number of employees using the facilities and the condition of such facilities comply with SABS 0400	Yes	
2(3)(c)	A clean means of drying hand is supplied at every washbasin	No	Prices of Driers are to be considered and a means of drying hands is to be installed.
2(3)(d)	Cleansing agent (soap) is to be supplied	No	A wall mounted liquid hand soap dispenser is to be installed
2(4)	Showers, under the circumstances in SABS 0400, are provided and are in accordance with the regulations	Yes	

2(5)(a)	Gender signs are up outside all bathrooms and change-rooms.	No	Signs are to be put up
2(5)(b)	Ventilation according to the National Building Regulations is provided	No	It is not known whether it conforms to the National Building Regulations as these regulations are not available
2(5)(c)	Wall partitions and doors are in place to ensure privacy	Yes	
3	Personal facilities for safekeeping of employees goods are provided and it is ensured that employees store their personal goods in these facilities	Yes	
4(1)	Change-rooms are provided	Yes	
4(2)	Regulations excepting for those below are adhered to:		
4(2)(b)	Adequate seating is provided	No	
4(2)(f)	Gender signs are up outside of change-rooms	No	Signs are to be put up
4(2)(h)	Ventilation according to the National Building Regulations is provided	No	See 2(5)(b)
4(3)	Eating or drinking is forbidden in change-rooms	Yes	
5	A separate eating place is provided and all regulations are adhered to	Yes	
6	Smoking, eating and drinking is prohibited in all workplaces and signs are up	Yes	
8	Adequate seats are provided for all employees who can perform their work sitting	Yes	
11.	Diving Regulations		
Not Applicable			
12.	Lead Regulations		
Not Applicable			
13.	Vessels Under Pressure Regulations		
Not Applicable			
14.	Lift, Escalator and Passenger Conveyor Regulations		
Not Applicable			



15.	Proclamation: Commencement of Section 1 and 2 of the Integration of Labour Laws Act, 1994 (94 of 1994) with Respect to Certain Laws		
Not Applicable			
16.	Regulations for the Integration of the Occupational Health and Safety Act		
Not Applicable			
17.	Regulations for Hazardous Chemical Substances		
3(1)	Before an employee is exposed to or may be exposed to a hazardous substance, s/he is adequately and comprehensively informed and trained and thereafter informed and trained at set intervals	No	A training manual is to be compiled in order to do the training. Information on hazardous substances is to be obtained from the MSDSs.
5(1) & (3)	A recorded assessment has been done and one repeated every 2 years to determine if any employee may be exposed to a hazardous chemical	No	The initial assessment is to be done and then one every two years
6(1)	For inhalation of hazardous chemicals, the measuring programme of the airborne concentration is carried out in accordance with the regulations.	No	No measurement programme is currently taking place.
8(a)	Any workplace where the concentration of hazardous chemicals in the air exceeds the recommended limit without the wearing of respiratory equipment, is classified as a respirator zone	Partial	Not all the workplaces have been checked whether concentrations exceed the recommended limit. Some have been classified as respirator zones
8(b)	Respirator zones are clearly demarcated	Yes	Those zones which have been classified are demarcated
9	Records of assessments, air monitoring and medical surveillance are kept and regulations adhered to	No	No records are kept because no assessments, air monitoring or medical surveillance has been done.
10(1)	Exposure to an employee is prevented or adequately controlled	Partial	In most instances exposure is prevented or controlled but there are still places where this is not done.
11(1)	Where exposure cannot be adequately controlled, protective equipment is supplied	Yes	



11(4)	Contaminated protective equipment is cleaned according to the regulations	No	Most protective equipment is not cleaned for long periods even if slightly contaminated. Equipment is only cleaned if very contaminated ie. Non-wearable otherwise
11(6)	Adequate washing facilities are supplied	Yes	
12	All control equipment and facilities are maintained in good working order (for engineering control measures this is to be done at intervals not exceeding 24 months)	Partial	Most control equipment and facilities are maintained in good working order. Engineering measures aren't maintained at the stipulated intervals.
13(a)	No person may use compressed air to remove particles of a hazardous substance from any surface	No	Compressed air is quite often used to remove particles of hazardous chemicals from surfaces.
13(b)	No smoking, eating, drinking or keeping of food and beverages is allowed in a respirator room	Yes	As with 10. Facilities Regulations (6)
14(a)	Hazardous chemicals in storage or distribution are properly identified, classified and handled in accordance with SABS 072 and SABS 0228	No	Some raw materials do not have identification markings on so it is not known whether they are hazardous or not. A lot of products only have codes on so the actual name or hazard classification is not known either.
14(c)	Any container into which a hazardous chemical is decanted, is clearly labelled with regards to the content	No	Often when a hazardous chemical is decanted there is only a code with no name or hazard classification
15(a)	As far as possible hazardous chemicals are recycled	Yes	
15(b)	All collected hazardous waste is placed in containers that will prevent exposure	No	Collected hazardous waste is sent out in their normal containers which won't always prevent exposure
15(c)	All containers which have come in contact with a hazardous substance are cleaned and decontaminated	Yes	
15(d)	Hazardous waste is disposed of only in sites specifically designated for this purpose in terms of the Environmental Conservation Act 1989 (73 of 1989)	No	

18.	Major Hazardous Installation Regulations		
Not Applicable			



## Appendix D. Hazardous Chemicals Analysis

Table 9-3: Table showing the method used to determine the hazardous chemicals

Code	Raw material	Highest Percentage in product	No. of products raw mat is in	Max quantity in stock [kg]	Enviro. hazard	Health hazard
			Shows only those raw mats which are hazardous			
PRE0007	METHYL PARABENE	0.30%			1	1
PERM005	MONOETHANOLAMINE	9.00%	9	302.7	2	3
QAT0027	N CETYLPYRID.CHLORIDE MONOHYDR	1.00%	1	45	5	4
SHAM029	NATRASOL 250 HHR	4.50%			1	1
SHAM014	Natrasol 250 HR	1.00%			1	1
SHAM050	NATRASOL 250 HR SPECIAL	1.25%			1	1
ALK0004	NEUTROL TE	3.00%			2	2
GEN0063	NICOTINAMIDE	0.10%			1	2
ACD0008	OLEIC ACID	4.30%			1	1
GEN100	PARAFFIN WAX EX58	Not Used				
GEN103	PARAFFIN WAX M3M	Not Used				
CON0002	PATIONIC 138C	8.00%			1	1
GEN0070	PATIONIC SSL	3.00%			0	0
GEN0033	PEG 200 CASTOR OIL/REWODERM LI	0.60%			1	1
EMU0008	PEG 40 HYDROGENATED CASTOR OIL	1.50%			1	1
EMU0007	PEG 60 HYDROGENATED CASTOR OIL	0.60%			1	1
REL0029	PEG-75 LANOLIN (LIQUID)	Not Used				
REL0028	PEG-75 LANOLIN (PASTE)	0.50%			1	1
GEN0022	PHENOXETOL	1.00%	10	158.1	3	3
ACD0001	PHOSPHORIC ACID 85%	0.95%	42	202	4	4
EMU0012	PLURONIC F127	1.00%			1	1
QAT0005	POLYQUATERNIUM 11	1.50%	12	254	3	1
QAT0004	POLYQUATERNIUM 6 (MERQUAT 100)	1.50%			1	1
EMU0011	POLYSORBATE 20	3.00%			2	1
ALK0005	POTASSIUM HYDROXIDE	0.70%	4	28.1	2	4
BLE0007	POTASSIUM PERSULPHATE	40.00%	7	1600	3	4
PERM013	POTASSIUM THIOGLYCOLATE 42%	Not Used				
PRE0001	PROPYL PARABEN	0.20%			2	2
REL0009	PROPYLENE GLYCOL	60.00%			1	1
CON061	PROTACHEM SMO	1.00%			1	1
PROT0003	PROTEIN SILK (CROSILK)	0.50%			0	0
LAQ0002	PVP K30	2.00%			2	1
LAQ0008	PVP K90	6.00%			2	1
LAQ0010	PVP VAE 735	1.50%			1	1
LAQ0006	RESYN 28-2930	4.86%			1	1
CON0021	RITACHOL 2000	Not Used				
PRE0009	ROKONSAL LJ	0.20%	2	30	3	3
EXT004	ROSMARY EXTRACT EGX 250	0.10%			1	1
GEN0075	SAFFLOWER OIL (VITAMIN F75%)	Not Used				
CON053	SALCARE SC96	1.00%			1	1
ACD0002	SALICYLIC ACID	0.20%	50	61.5	2	4
SIL0009	SILIC F/GUM BLEND 1214(DC1401)	100.00%	12	562	3	3
SIL0002	SILICON DC 1520 ANTIFOAM	0.01%			0	0
SIL0003	SILICON DC 193 (SF 1288)	9.50%			0	0
SIL0001	SILICON DC 556 (SF1550)	10.00%			0	0
SIL0005	SILICON DC 929	2.00%			0	0

Code	Raw material	Highest Percentage in product	No. of products raw mat is in	Max quantity in stock [kg]	Enviro. hazard	Health hazard
			Shows only those raw mats which are hazardous			
SIL0013	SILICON DC200/100 CST	Not Used				
SIL0014	SILICON DC200/1CST	98.00%			0	0
CON0031	SILICON SM 2115-D2	6.20%			0	0
SIL0019	SILICONE DC 244	Not Used				
SIL0030	SILICONE DC 5330	2.00%			0	0
SIL0016	SILICONE DC190	Not Used				
SIL0015	SILICONE DC200 0.65 CST	73.70%			0	0
SIL0007	SILICONE DC344(volatil)SF1204	89.90%			0	0
SIL0024	SILICONE FLUID 46/200(SF96-200	11.20%			0	0
SIL0008	SILICONE GE 1708-D1(DC Q28220)	0.50%	8	25	4	3
SIL0021	SILICONE SF 1173	1.00%	1	15	3	3
SIL0009/PHS	SILICONE SF1214 / PHS	Not Used				
ALK0006	SOD.HYDROXIDE 25%	0.83%	13	820	5	4
BLE0012	SOD.METASILICATE ANHYD.POWDER	21.50%			1	1
GEN0073	SODIUM ACETATE	0.11%			2	2
GEN0049	SODIUM BENZOATE BP	0.50%			1	1
NEUT001	SODIUM BROMATE	11.00%			1	2
GEN0026	SODIUM CARBONATE ANHYDROUS	1.00%			2	2
BLE0014	SODIUM CARBONATE PEROXOHYDRATE	Not Used				
SHAM008	SODIUM CHLORIDE	7.00%			1	1
GEN0019	SODIUM DITHIONITE	0.02%	5	42.6	3	4
ALK0001	SODIUM HYDROXIDE	10.00%	51	320	4	4
GEN0098	SODIUM ISOASCORBATE	0.20%	6	50	4	4
SHAM001	SODIUM LAURETHSULPH.27%	50.00%			2	2
SHAM037	SODIUM LAURETHSULPH.70%	38.40%			2	2
SHAM049	SODIUM LAURYL SULFATE 28%	Not Used				
GEN0097	SODIUM METABISULFITE	0.40%			2	2
GEN106	SODIUM NITRITE Extra Pure	0.20%	1	50	5	4
BLE0010	SODIUM PERSULPHATE	25.00%	8	3178	2	4
EMU0009	SODIUM STEARATE (Powder)	4.20%			1	1
BLE0025	SODIUM SULFITE (ANHYDROUS)	0.45%			2	1
SHAM045	SODIUM SULPHATE	Not Used				
SHAM044	SODIUM THIO SULPHATE 5H2O	Not Used				
BLE0011	SODIUMSILICATE 5 H2O	25.00%			1	1
SOL0002	SOLVENT ETHOXY ETHANOL	Not used				
SOL0001	SOLVENT ID ISODODECANE	85.60%			2	2
ACD0005	SORBIC ACID	0.20%			2	2
GEN0047	STEARYL ALCOHOL	8.00%			2	1
DET0016	SULPHONIC ACID	8.00%	1	200	5	5
OIL0001	SUNFLOWER OIL	2.44%			1	1
CON0022	SUPERSAT AWS - 4	Not Used				
DET0011	SURFADONE LP 300	1.00%	7	196	4	3
Number Descriptions						
No	Environmental		Health			
0	None		None			
1	Easily eliminatable - no ecological hazard		Only slight irritation			
2	affects water quality		Irritation			
3	Large quantities can cause ecological damage		Dangerous			
4	Hazardous - causes death to ecological life		Hazardous - Could cause death in large quantities			
5	Extremely Hazardous		Extremely Hazardous			

# Appendix E. Effluent Water Test Results

## Modderfontein Laboratory Services (Pty) Ltd

Reg. No. 1966/001741/07

P.O. Box 27

Modderfontein

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Tel : +27 (011) 606-2274

### Analytical Report

12 May, 2004

Attention B. Wilkie

Type of Sample Effluent water

Analysis Required As below

Identity	ppm As	ppm Se	ppm Mo	ppm Ag	ppm Ti	ppm Sr	ppm Mg
BX 280404	< 1	< 1	< 0.3	< 0.5	0.9	< 0.1	7.4

Identity	ppm Al	ppm Ni	ppm Be	ppm Hg	ppm Mn	ppm Fe	ppm Cr
BX 280404	1	< 0.5	< 0.1	< 1	0.08	2.2	< 0.1

Identity	ppm V	ppm Na	ppm B	ppm Ca	ppm P	ppm Zn	ppm Cu
BX 280404	< 1	76	< 1	28	3.2	0.6	0.08

Identity	ppm Sb	ppm Pb	ppm Li	ppm Co	ppm Cd	ppm K	pH
BX 280404	< 0.3	< 0.5	0.2	< 0.1	< 0.02	9.8	8.4

Identity	ppm Anionic Surfactant	ppm Kj-N/N	ppm Oil & Grease
BX 280404	79	14	417

Identity	ppm NO <sub>2</sub>	ppm NO <sub>3</sub>	ppm NH <sub>3</sub>	ppm TOC	ppm COD	mS/m EC
BX 280404	< 1	< 1	12	900	6 715	57

Identity	ppm Suspended Solids
BX 280404	144

Analysed By : J.S. L.M.

Supervisor : C. Kelly

Figures contained in this report are not absolute, but are subject to an analytical uncertainty of +/- two standard deviations, the value of which is available on request from the Chief Chemist.

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Figure 9-10: Chemical Analysis of the effluent water

## Appendix F. Acceptable Discharge Limits

Information is from Ekurhuleni Metropolitan Municipality, 2003b

### (i) GENERAL:

Table 9-4: Acceptable discharge limits for general substances

Determinants	Upper limits of concentrations	Actual tested results
pH at 25°C	6.0 - 10,0 (Upper and lower limits)	8.4
Electrical conductivity at 25°C	500 mS/m	57 mS/m
Caustic alkalinity (expressed as CaCO <sub>3</sub> )	2000 mg/l	-
Substances not in solution (including fat, oil, grease, waxes and like substances) and where the volume of effluent discharged per month does not exceed 10 000 kl	1000 mg/l	900
Substances not in solution (including fat, oil, grease, waxes and like substances) and where the volume of effluent discharged per month does exceed 10 000 kl	500 mg/l	N/A (effluent water does not exceed 10 000 kl)
Fat, oil grease, waxes and like substances soluble in petroleum ether	500 mg/l	417
Sulphides, (expressed as S)	10 mg/l	*
Hydrogen sulphide (expressed as H <sub>2</sub> S)	5 mg/l	*
Substances from which hydrogen cyanide can be liberated in the drainage installation, sewer and sewage treatment works (expressed as HCN)	20 mg/l	N/A (There are no cyanide containing raw materials)
Formaldehyde (expressed as HCHO)	50 mg/l	*
Non-organic solids in suspension	100 mg/l	144 mg/l
Chemical oxygen demand (COD)	5000 mg/l	6715 mg/l
All sugars and/or starch (expressed as glucose)	1500 mg/l	*
Available chlorine (expressed as Cl)	100 mg/l	?
Sulphates (expressed as SO <sub>4</sub> )	1800 mg/l	*
Fluorine-containing compounds (expressed as F)	5 mg/l	*
Sodium (expressed as Na)	500 mg/l	76 mg/l

Table 9-4: Acceptable discharge limits for general substances - Continued

Determinants	Upper limits of concentrations	Actual tested results
Anionic surface active agents	500 mg/l	79 mg/l
Ammonium Nitrogen as N	200 mg/l	12 mg/l
Orthophosphate as P	50 mg/l	3.2 mg/l
Phenols	150 mg/l	*
Chloride (Cl <sup>-</sup> )	500 mg/l	?

\* - Not tested for but should be less than the required limit because not a lot is used in the raw materials

? – Not tested for and could be higher than the required limit because some raw material do contain this element

## (ii) Metals And Other Elements:

### Group A

Table 9-5: Acceptable discharge limits for group A metals and elements

Determinants	Upper limits of concentrations	
Nickel (expressed as Ni)	20 mg/l	<0.5 mg/l
Zinc (expressed as Zn)	20 mg/l	0.6 mg/l
Cobalt (expressed as Co)	20 mg/l	<0.1 mg/l
Chromium (expressed as Cr)	20 mg/l	<0.1 mg/l

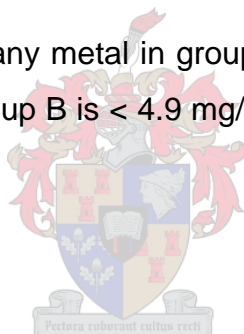
The individual concentration of any metal in group A is than required and the total concentration of all metals in group A is < 1.3 mg/l which is much less than 40 mg/l as required

## Group B

Table 9-6: Acceptable discharge limits for group B metals and elements

Determinants		Upper limits of concentrations	
Lead	(expressed as Pb)	5 mg/l	<0.5 mg/l
Copper	(expressed as Cu)	5 mg/l	0.08 mg/l
Cadmium	(expressed as Cd)	5 mg/l	<0.02 mg/l
Arsenic	(expressed as As)	5 mg/l	<1 mg/l
Boron	(expressed as B)	5 mg/l	<1 mg/l
Selenium	(expressed as Se)	5 mg/l	<1 mg/l
Mercury	(expressed as Hg)	5 mg/l	<1 mg/l
Molybdenum	(expressed as Mo)	5 mg/l	<0.3 mg/l

The individual concentration of any metal in group B is than required and the total concentration of all metals in group B is < 4.9 mg/l which is much less than 20 mg/l as required.



## Group C

Table 9-7: Acceptable discharge limits for group C metals and elements

Determinants		Upper limits of concentrations	
Aluminium	(expressed as Al)	20 mg/l	-
Iron	(expressed as Fe)	20 mg/l	2.2 mg/l
Silver	(expressed as Ag)	20 mg/l	<0.5 mg/l
Tungsten	(expressed as W)	20 mg/l	-
Titanium	(expressed as Ti)	20 mg/l	0.9 mg/l
Manganese	(expressed as Mn)	20 mg/l	0.08 mg/l

The individual concentration of any metals in group C is less than 20 mg/l as required