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NATIONAL CLEANER PRODUCTION
CENTRE SA

NCPC
national cleaner production centre
South Africa

CONTRACT REPORT

IPA REPORT – BOKOMO BREAKFAST FOODS

086DG / HY7AGRO

Prepared for:	**Mr S Windell** **Bokomo Breakfast Foods (Oats)** **P.O. Box 319,** **Epping Industrial,** **7475**
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IPA REPORT – BOKOMO BREAKFAST FOODS

28 September 2007

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EXECUTIVE SUMMARY

This report outlines the activities undertaken during a Prevention Quick Scan of the Bokomo Oats manufacturing site in Epping Industria, Cape Town. The project is part of a Cleaner production Demonstration Project for the Agroprocessing sector coordinated by the National Cleaner Production Centre (NCPC). Bokomo Foods is the largest breakfast foods company in South Africa. In the pursuit of sustainable development they have also joined the Waste Minimisation Club for the Epping industrial Area.

On 28 December 1920 Bokomo was officially registered under the Companies Act of 1892. Thus the long awaited co-operative deal, which would put the interest of the farmer first and foremost, was realised. Only bona fide farmers could become members and the new organisation brought much needed stability to the wheat industry.

Bokomo Foods is the biggest name in breakfast cereals in South Africa ranging from cold- to hot- and convenience cereal. Bokomo belongs to the Pioneer Food Group which has more than 200 different listed food products in retail. It is one of the biggest food companies in South Africa. One of the product ranges within Bokomo is the Oats range. The Oats plant has 11 different products

Bokomo sells directly to the largest retailers within South Africa viz, Pick 'n Pay, Woolworths, Spar and Shoprite. This indicates that they are in direct contact with consumers and branding is very important. The oats suppliers vary from national and international suppliers. Packaging materials is supplied by local suppliers such as NAMPAK.

The company is located in an industrial area with 3 operations taking place on one site. All three operations belong to the Pioneer food group. One is form the Moirs baking ingredients range, the second is from the Sasko milling group and the third is Bokomo Oats. Energy bills are split between these plants proportionally as well as the water consumption.

The company has a five star rating for the NOSA group, which is a South African Safety Health and Environment management certification body. Bokomo Oats do not employ any other certification systems. They utilise SAP for their financial management system. Bokomo aims at maintaining an ISO 9000 & HACCP in quality management.

There is no defined energy management system in place for Bokomo Oats. Peak Demand Monitoring take place via an external party but information have not been communicated to employees. An account of the kWh and the kVA consumed is monitored for the entire plant but it is not divided for the specific processes within Bokomo Oats. No account of steam monitoring takes place either.

The total cost of water is about R 41 000 which is about 6300 kL of water per year. This amount is almost entirely consumed by the boiler. A small percentage of this water is used for cleaning and sanitation. Some of the condensate is returned to the boiler. All the wastewater is disposed directly to the sewer system. No major problems have been experienced with the wastewater pollution being disposed to date.

Various waste streams have been identified during processing. Some of these waste streams are re-used or recycled, some are disposed to landfill. Waste streams range from specific production waste to general company waste. The company now has a waste recycling company on board to reduce the amount of waste going to landfill.

Screenings is waste which comes with the oats and is removed from the usable product. This waste would go to the farmer for cow meal. All oats production waste, generated by dust, leaking machinery, dehulling, grading etc, is also externally reused as cow meal.

Packaging waste such as plastic wrapping and carton waste is mostly recycled if it is not contaminated or soiled. These will be disposed of to landfill. A lot of waste has been generated by the packaging department on the instant oats line. This waste occurs during start up of the machinery as the optimum settings have not been found. On average at least one cubic metre bag gets filled per day. This product waste is disposed to landfill. Bokomo Foods has been able to reduce their waste to landfill by 65% by implementing an on site sorting system.

The biggest problem highlighted by the oats manager is the waste generated by the Messpack machine. This has been used as one of the focus areas for the IPA phase. From the ECO inspector tool (et up by UNIDO) a graph indicating the economic potential vs. the environmental potential for CP is shown above. The processes in the top right hand quadrant indicate areas where further investigation should be made. These areas include:

- Cooking
- Roasting
- Drying
- Packaging
- Compressed air
- & Process heat (steam)

CONTENTS

1. PREFACE

This report outlines the activities undertaken during a Prevention Quick Scan of the Bokomo Breakfast Cereals in Epping. The project is part of a Cleaner production Demonstration Project for the Agroprocessing sector coordinated by the National Cleaner Production Centre (NCPC). The programme has been designed for the needs of companies ready to analyze and optimize their internal business processes with a view to developing Cleaner Production (CP) techniques and to implement Environmentally Sound Technologies. This will allow the companies to reduce both their operating costs and the environmental performance, thus increasing their productivity and competitiveness. The project provides opportunities for staff training and technical consulting. It is targeted at executives and technically skilled employees (such as managers with a special brief for environmental affairs).

Further information can be found on the internet www.ncpc.co.za. Before a company is analyzed in detail, a *Quick-Scan* is usually conducted. The Quick-Scan is a short analysis which assesses the quality of the crucial processes, material- and energy flows in order to identify the *potentials* for CP. I.e. with the Quick-Scan the process areas with good optimising potentials are found and a possible focus for further analysis can be defined. On the basis of the Quick Scan, the company will decide whether or not and in which process areas an in-depth analysis (the CP Assessment) shall be conducted.

2. PROCEDURE

A consultant from BECO - Institute for Sustainable Business, Zubeida Zwavel, is part of a consulting team leading the Cleaner Production project. Support is provided by Thomas Beurki and Johannes Fresner of UNIDO. The project consists of two phases the Quick Scan (QS) and the In Plant Assessment (IPA). The Quick Scan aims to examine the potential for Cleaner Production to be implemented at SAB Newlands.

It required close cooperation between the consultant and the participating company (Bokomo). Therefore a walkthrough was conducted at SAB Newlands by the consultant team and members of the engineering department. This was followed by request for information in the form of a questionnaire. The questionnaire was sent to Bokomo and a meeting was held with the Plant manager to fill in gaps.

Thereafter the detailed In Plant Assessment phase took place with internal discussions, observations and monitoring. The people involved from the different parties are shown below

From Bokomo Breakfast Cereals.:

Mr S Windell (Plant Manager)

From the CPC*:*

Mrs. Zubeida Zwavel (BECO – Institute for Sustainable Business)
Dr. Thomas Bürki (UNIDO)
Dr Johannes Fresner (UNIDO)
Mr .Manogaran Ram Reddi, (National Cleaner Production Centre)

3. SHORT ANALYSIS

3.1 The Enterprise

During the first quarter of the twentieth century the wheat farmers of the Western Cape experienced difficult times. There was no control over the wheat industry, wheat prices fluctuated and farmers often faced losing everything. For these reasons seven men with vision signed the Memorandum and Articles of Association of "De Boeren Ko-operatieve Molen Maatschappij Beperkt (BOKOMO) in December 1920. On 28 December 1920 Bokomo was officially registered under the Companies Act of 1892. Thus the long awaited co-operative deal, which would put the interest of the farmer first and foremost, was realised. Only bona fide farmers could become members and the new organisation brought much needed stability to the wheat industry.

Bokomo has developed into one of the most important organisations in the industry. The small group of pioneers has grown into a work force of more than 10 000 employees. Bokomo's market leadership has enabled the company to form strategic alliances internationally specifically the UK.

Table 1: Company overview

- Company Name	Bokomo Breakfast cereals
- Address	P.O. Box 319, Epping Industrial, 7475
- Phone, Fax	+27 21 534 5240
- e-mail	swindell@pioneerfoods.co.za
- web	www.pioneerfoods.co.za
- Trading Since (year)	1920
- No. of Employees	41
- Industrial Process used	Steam generation, compressed air generation Grading, dehulling, cutting, cooking, flaking drying, packing
Environmental Team:	
- assigned Environmental Manager and position within the organization	Roche Vermaak
- Team members and positions	Steven Windell (Plant Manager)

Contact Person: Phone : Mobile: E-mail:	Steven Windell, 021 534 5240, 0828733340 swindell@pioneerfoods.co.za

3.2 Manufacturing Processes

3.2.1 Process Overview

This section provides an overview of the departments of the enterprise and the processes.

Figure 1: Flowchart of production process for Bokomo Breakfast Cereals Oats

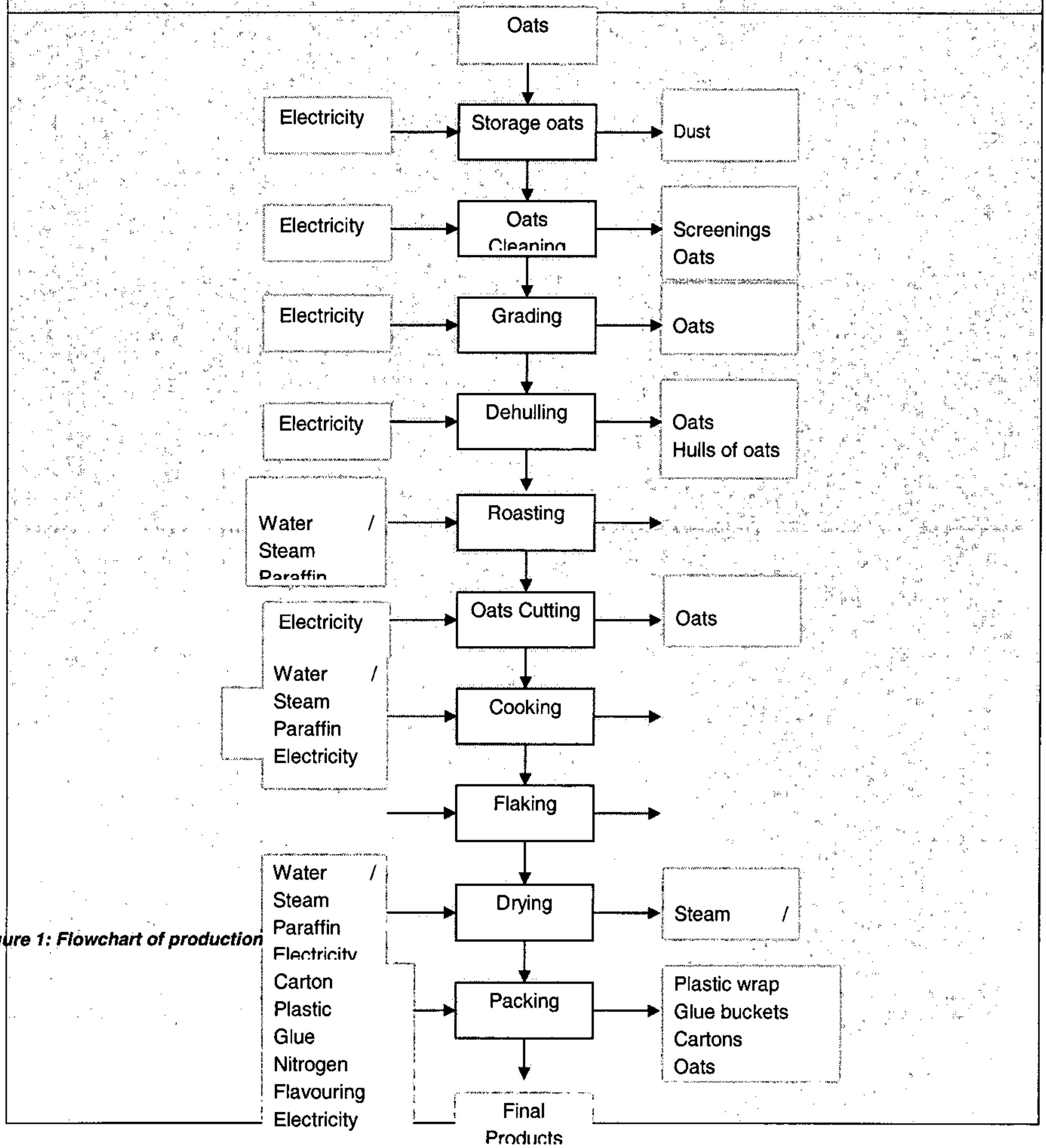


Figure 1: Flowchart of production

3.3 Process Description

The description of the process steps of the Flow Chart is given below.

The Oats are transported by rail to the plant where the oats goes via a conveyer belt from the train into big silos where it is stored. When the oats are needed it goes underground via a conveyer belt from the silos to the oats factory.

The first step is to clean the oats from screenings (stones, dust, unwanted material etc). All screenings is separated from the oats and the screenings continue further in process as cow meal. After the oats are cleaned from the screenings, the oats are graded into small, medium, large and crushed oats. These separated kinds of oats is stored in separate silos. The next step is to dehull the oats. Once removed from the oats the hulls will continue further in process as cow meal and the de-hulled oats is roasted in a big roaster which utilises a large amount of steam.

The roasted oats is then cut into pieces before it goes into the cooker. In the cooker the oats is boiled with high pressure steam to clean and disinfect the oats. The wet oats is rolled and flaked into flat oats. The flat oats is dried in a warm air dryer which is warmed by high pressure steam. The moisture from the oats goes into the atmosphere. The oats is then ready for consumption and is packaged in different flavours and quantities by the packaging department.

3.4 Storage

Large quantities of oats comes in via rail either from the harbour whereby it is put on conveyer belts and transported to large silos. On average Bokomo Oats uses about 11 000 tons of oats per year which is stored in these silos. These oats cost R 1500 per ton thus it is the highest purchasing cost for the factory. This storage method is suitable for bulk storage and the system of transport is optimised. Intermediate storage of materials takes place for packaging materials. The warehouse holds all outgoing products. All storage is based on the First in First out principle. Appendix 1 shows the raw material and auxiliary material costs for the year.

3.5 Transport

Bokomo transports their own goods to and from the sites. Not much knowledge exists at this point of the external transport of employees. Transport internally can also be optimised as the shortest routes are not necessarily taken due to the layout of the factory.

3.6 Energy management

There is no defined energy management system in place for Bokomo Oats. Peak Demand Monitoring take place via an external party but information have not been communicated to employees. An account of the kWh and the kVA consumed is monitored for the entire plant but it is not divided for the specific processes within Bokomo Oats. No account of steam monitoring takes place either.

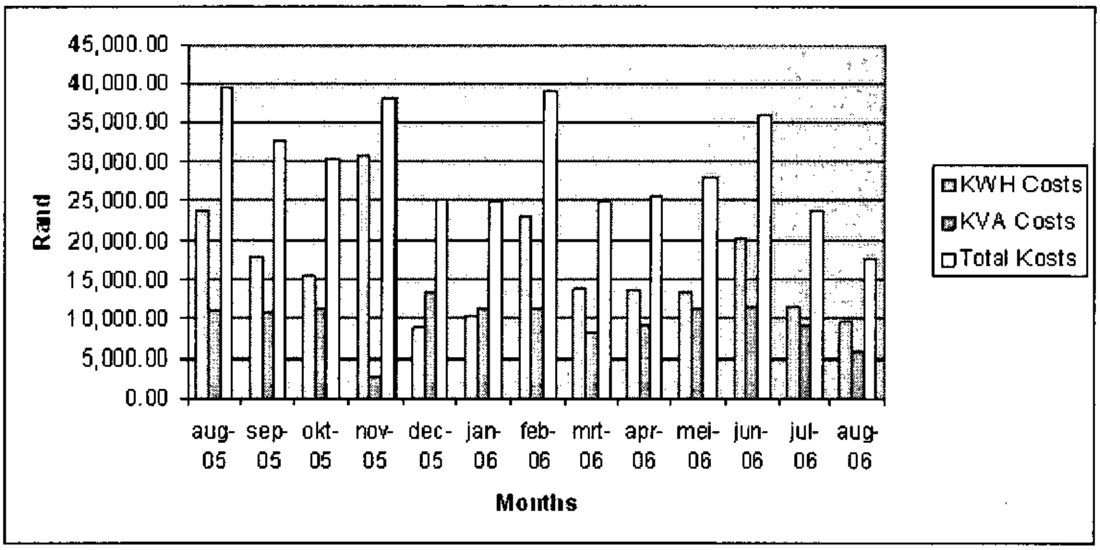
3.7 Energy provision – Electricity

Electricity is one of the largest energy costs within Bokomo Oats. The annual electricity cost from August 2005 till the end of July 2006 (for combined KWH energy consumption as well as KVA peak demand consumption) is approximately R 367 953. The total machinery of the oats factory uses 96.5% of the total electricity consumption. The lighting uses about 3%. High electricity demand was reached in the months of August 2005, November 2005, and February 2006.

Table 2: Energy costs

	Amount per year	Cost per year
KWh	1 382 460	R 201,977
KVA	2 776	R 120,788
Total annual electricity costs		R 322,766
Total annual electricity costs inc. tax rates		**R 367,953**

Figure 2: Overview electricity costs division



3.8 Energy Provision – Process Heat

Bokomo Oats has one paraffin boiler supplying steam to the entire plant. The paraffin costs about R 767,587 and is the highest contributor of the energy cost at BOKOMO oats factory. The Plant manager said that the boiler produces about 1.3 tons of steam per hour. The steam pressure is at 8-10 bars. The processes only utilise steam at a pressure of 3-4 bar. The temperature of the steam is round 130 degrees. Steam is used for roasting, cooking, cleaning and drying the oats. The condensate which exists in the pipes, valves and the radiator of the dryer is lead back to the boiler. Some moisture goes into the products during boiling and some goes into the atmosphere by drying with hot air. Boiler blowdown takes place once every five hours. During the walkthrough quite a few un-insulated piping and connections was observed, The temperature in the boiler room is also quite high. This is due to the un-insulated boiler which loses heat by means of radiation and conduction. Some pipes and valves leak steam which is also not regularly fixed. Steam leaks represent significant energy losses over a year.

3.9 Energy provision – Compressed Air

There is one compressor at the rear of the factory which is not very close to the point of use. Upon the 2 occasions during site walkthroughs the compressor room was locked and no inspection has been done of the compressor. Compressed air is used in the pneumatic system for valves and slides. Compressed air is a vital part of the production process and comes from a combined compressed air system. Some of the compressed air piping, flanges and valves have leaks in them. Compressed air leaks are significant sources of waste energy and results in excess compressor capacity. The compressed air operates at 4 bar in certain areas but it is unknown what the pressure is at discharge of the compressor.

3.10 Water consumption

The total cost of water is about R 41 000 which is about 6300 kL of water per year. This amount is almost entirely consumed by the boiler. A small percentage of this water is used for cleaning and sanitation. Some of the condensate is returned to the boiler. All the wastewater is disposed directly to the sewer system. No major problems have been experienced with the wastewater pollution being disposed to date.

3.11 Solid Waste generation

Various waste streams have been identified during processing. Some of these waste streams are re-used or recycled, some are disposed to landfill. Waste streams range from specific production waste to general company waste.

Screenings is waste which comes with the oats and is removed from the usable product. This waste would go to the farmer for cow meal. All oats production waste, generated by dust, leaking machinery, dehulling, grading etc, is also externally reused as cow meal.

Packaging waste such as plastic wrapping and carton waste is mostly recycled if it is not contaminated or soiled. These will be disposed of to landfill. A lot of waste has been generated by the packaging department on the instant oats line. This waste occurs during start up of the machinery as the optimum settings have not been found. On average at least one cubic metre bag gets filled per day. This product waste is disposed to landfill.

There is also waste which is dumped in a general container. This waste is mainly plastic packaging which can't be reused or recycled because it is polluted. The container is commonly used by the whole site including all the other factories as well. The container is removed on average 2-3 times per week. The total disposal costs come to about R 150 000 per year The exact amount generated by the Oats factory alone is unknown.

4. FINDINGS OF THE QUICK SCAN

4.1 Data Evaluation: Estimation of CP Potentials

4.1.1 Assessment of processes

The data collected during the company visit were evaluated with the software-tool *Eco Inspector*. The CP potential of individual process steps, including those covering energy provision and storage management, was examined in accordance with the following criteria:

Inputs:
- Are there any problem materials which are hazardous to the environment or to health?
- Are large volumes of raw, auxiliary and operating materials used?
- Is the level of energy consumption high?
- Are major costs incurred on the input side (materials or energy)?

Outputs:
- Are large volumes of (problematic) waste, special waste, wastewater, wastewater components or emissions generated?
- Are high internal/external preparation and disposal costs incurred?

Technology:
- Is the applied technology state of the art?
- What is the level of automation?

- Are there losses incurred through faulty batches or scrap?
- How are the systems serviced or cleaned?
- Are high costs incurred for maintenance, cleaning, and stoppages?

Each process step was qualitatively checked on these criteria and was classified according to the following scale:

Table 4 Potential Points – Assessment of Potential Level for Each Criterion

Criterion not applicable to this process area, or no CP potential	Zero points
Moderate CP potential anticipated	1 point
Significant CP potential anticipated	2 points

The next step examines each sub-process as an entity according to the scale in Table 2 to determine the actual level of optimisation already achieved; i.e. whether or not the CP potential is already exhausted. Thus the "relevance" of the identified potentials is described and a weighting factor is defined. This is a qualitative estimate and draws on the experience of the person conducting the Quick-Scan (expert opinion).

Table 5 Scale for Estimating the Level of Optimisation of the Current Process (weighting factor)

Level of optimisation "high"	Optimisation potential largely exhausted	0 Points
Level of optimisation "high to medium"		0.5 Points
Level of optimisation "medium"	Optimisation potential not fully exhausted	1.0 Point
Level of optimisation "medium to low"		1.5 Points
Level of optimisation "low"	Non-optimised process step	2.0 Points

The product of the potential point and weighting factor indicates the *current CP potential* for each criterion point of each sub-process.
The average of points for the individual categories (Inputs, outputs, technology and cost) gives a benchmark for the CP potential of individual process steps. This enables a rapid comparison of the sub-processes and facilitates selection of the processes for more detailed analysis.

4.2 Discussion of Results

The graph shows that the bottling and packaging has the highest potential for Cleaner Production due to the potential of reusing the water. Energy management is well optimised with preventative maintenance and regular audits in place. The Lauter Tun process can also be optimised due to the spent grain removal. Solid waste and wastewater has been incorporated in each process step.

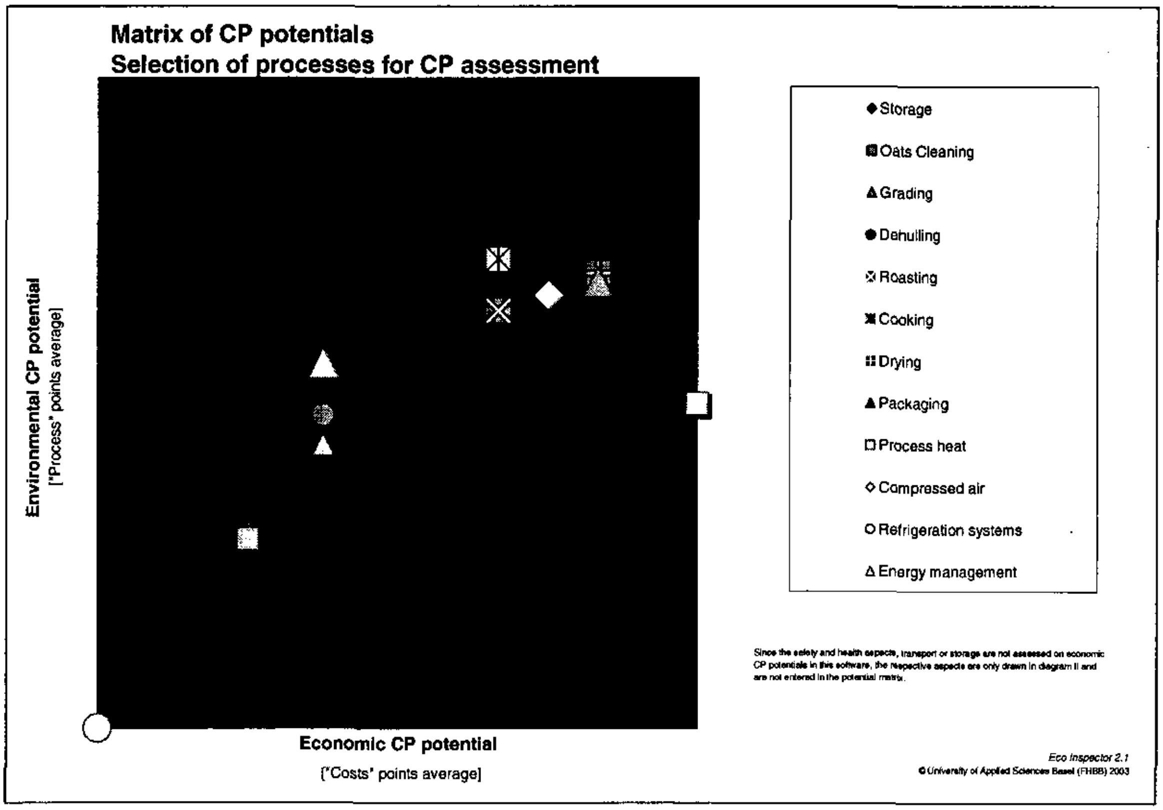


Figure 3: Matrix of CP Options

From the ECO inspector tool (et up by UNIDO) a graph indicating the economic potential vs. the environmental potential for CP is shown above. The processes in the top right hand quadrant indicate areas where further investigation should be made. These areas include:

- Cooking
- Roasting
- Drying
- Packaging
- Compressed air
- & Process heat (steam)

5. DETAILED ASSESSMENT (MESSPACK MACHINE)

A presentation was made to Bokomo on the results of the Quick scan. Some preliminary options were already highlighted to them and were discussed with the engineering team who decided that the project would focus on the packaging machine for the oats (Mess Pack Machine). Further investigation was done by requests for information; metering and monitoring took place and several discussions with various parties within Bokomo.

5.1 Overview of problems identified

The Messpack machine is used to package various flavours of instant oats as well as potato mash powder. The major problem that the machine is experiencing is that a large amount of product is lost during the packaging operation. Compounding this problem is the fact that a large number of packaging pouches are also lost. This implies that glue and wear and tear of the scissors are also loss factors on the machine. A large amount of electricity is also wasted if there is a low efficiency of the machine.

The obvious problems that the machine experiences are:

- Slipping of packets during the packaging process.
- Miss-alignment of packets.
- Opening of packets.
- Dosing nozzle size too large.
- Insufficient amount of product released into packets.
- Filters
- Dust

5.1.1 Slipping of packets during the packaging process

The grippers that move the packets from the LHS to the RHS of the machine are sometimes miss-aligned. This will cause some packets to slip and fall down. The packets are more likely to fall down if they are being filled due to the extra weight of the product entering the packet.

5.1.2 Opening of packets

After the packets are cut, the suction probes will open the packets. Due to the insufficient pressure, the suction probes will at times cause packets to be partially opened. This causes the product to fall short of the opening of the packet. Dosing nozzle size too large

The dosing nozzle of the machine move down and release the product into the packet. Due to miss-alignment, the nozzle will move down and some product will be released outside the packet. Eventually this partially filled packet will be rejected at the final stage of the machine. Placing a smaller diameter adapter over this nozzle will ensure that the entire product will be released into the packet even if there is slight miss-alignment of the packets. The filling time for the packet will be slightly longer due to the smaller diameter of the discharge nozzle. This can be remedied by slightly decreasing the time to complete one cycle. There will be a trade-off between packaging time versus the amount of product lost. It must be decided which option is more profitable in the long run.

5.1.3 Filters

The compressed air is filtered by special filters that are not readily available and need to be ordered beforehand. On our last visit to Bokomo the operator commented that the filters were fouled and that the maintenance controller had difficulty in cleaning these filters. While a new batch of filters were being ordered the machine was in desperate need of clean filters. .

5.1.4 Dust

One of the major problems at Bokomo Foods is the presence of product dust that is released into the air while the product is transported via conveyer belts. The packaging machine accumulates a lot of dust inside and outside of the moving parts. Little can be done about the amount of dust because extractor fans are already in place. The operator can at regular time intervals wipe off the grippers and suction probes to ensure better grip of packets during the filling process.

5.1.5 Mass Balance

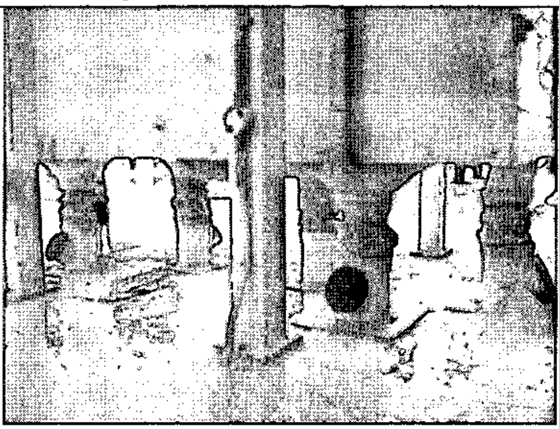
A period of a week was taken for the observation and monitoring of loss at the machine which was averaged at about 10 kg per hour of raw materials. See table below.

Table 3 Messpack Packaging material losses:

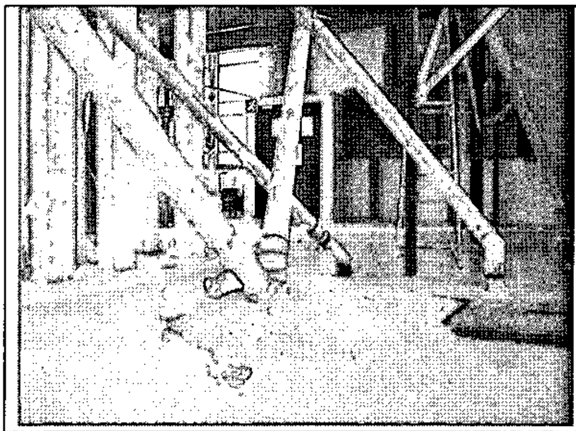
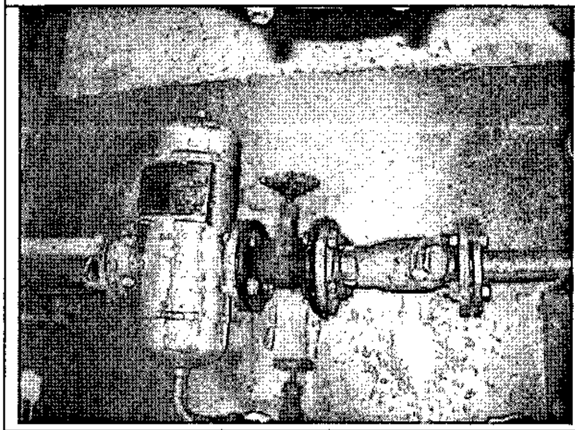
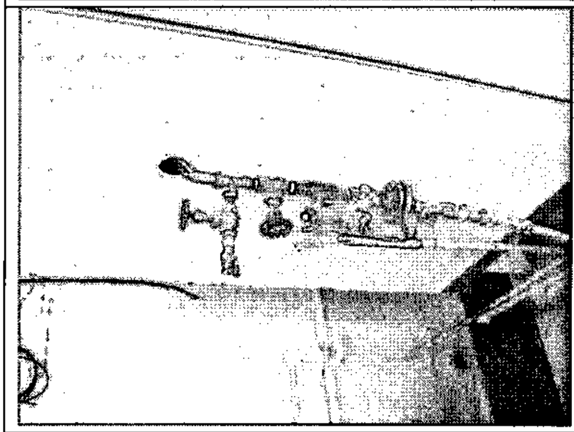
Item	units	
Average product lost per hour	grams	10166
Average lost per year based on 4 hours operation per day (5d/w)	Kg/yr	6 478
Cost of raw materials lost per year		**R 18 000**
Average number of packets lost per hour	Packets	893
Total packets lost for year based on 4 hours operation per day (5d/w)		874823
Cost of loss of packets		**unknown**
Lost revenue due to unsold packets		**R 1 749 647**
*the product is sold at R 20 per box for 10 sachets (R 2 per sachet)		

5.2 Findings during walkthroughs

Walkthroughs were conducted and observations made during these walkthroughs were the following.



Material losses throughout plant

	Material losses throughout plant
	Steak leaks (corrosion visble
	Heat loss due to minimal insulation
	Messpack Material losses

6. RECOMMENDATIONS AND FOLLOW UP

The quick scan and IPA report generated several CP options which have been listed in the table below. These are rated according to ease of implementation, technical feasibility, economic viability, environmental evaluation and implementation decision. These columns contain either, 'pos'; 'med' or 'neg' which equate to either, positive (yes), neutral (don't know) or negative (No). These CP options were discussed during the closing presentation held at Bokomo

6.1 Description of CP options

Table 4: CP Options

	Description of CP Option[1]	Directly Implemented[2]	Technical Feasibility	Economic Viability	Environmental Evaluation	Implementation Decision	Investment (R)	Savings (R)
1.	Detailed monitoring and benchmarking	Pos	Pos	Pos	Pos			Unknown
2.	Proper training for operators	Pos	Pos	Pos	Pos			Unknown
3.	Sweeping the floor more.	Pos	Pos	Pos	Pos			Unknown
4.	Turn off lights when not in use	Pos	Pos	Pos	Pos		no	R 4000 per year
5.	Improvements in the steam system	Pos	Pos	Pos	Pos		medium	R 150 000 per year
6.	Compressed air leaks	Pos	Pos	Pos	Pos		Payback within 6 months	R 70 000 per year.
7.	MessPack Machine material losses	Pos	Pos	Pos	Pos		low	At least 50% saving
8.	Management systems	Neg	Pos	Pos	Pos		Medium	Payback 2-3 years

6.2 Good Housekeeping options

6.2.1 Detailed Monitoring and Benchmarking

Operations that begin monitoring their resource consumption and actively set targets find reductions of between 2 – 5% of their resource consumption in the short to medium term. To this extent, we would recommend installing live metering of the main resource usage points such as steam, electricity and water. The investment costs depend on the level of automation and the number of monitoring points.

6.2.2 Training of operators

Staff which are skilled in the area of operation has been proven to have a direct effect on the production. For Bokomo a marked difference could be noticed in waste generation due to improved skills and capacity building of operators.

6.2.3 Cleaning of floors

Cleaning can account for as much as 70% of a site's water use within food companies. Changing cleaning routines to optimise water use will not only cut your water supply bills but can have the added benefits of reducing the volume and concentration of effluent. Remember, too, that excessive use of water for cleaning brings many additional costs, such as labour, downtime, lost materials, cleaning chemicals and energy for heating and pumping. Also monitor the dosification of chemicals for cleaning.

6.2.4 Turn off lighting when not in use

This is a very easy, no cost CP option aimed at reducing the energy spent on lighting when no-one is on the premises or within a room. The lighting from outside on the floors 3 & 4 is sufficient and windows can be cleaned to ensure optimum lighting, very few operators are in this area. This could result in saving of about R 4 000

6.3 Energy Efficiency

6.3.1 Improvements in the steam system

Insulation
The high temperatures in the steam piping system allow the insulation to be very cost-efficient. In practice the boiler shell is usually insulated, however, the boiler face, piping, valves and flanges are often not insulated

Fix Steam leaks
Steam leakages at valves, safety devices and gauges cost companies lots of money. See calculation below

Boiler Blowdown
Unnecessary blowing down the boiler water is a waste of money, while too little blowdown pollutes the boiler. The quality of the boiler water can be checked by using a conductivity meter. When checking, account for the amount of chemicals used. The optimised value of conductivity of the boiler water is 6.000 to 7.000 µS.

Decreasing the steam pressure: If the demanded pressure level is lower than the steam pressure in the boiler an overall reduction of the steam pressure can be considered. This applies both to central and decentralised generation. If there is a location where high pressure is demanded one can opt for a separate (decentralised) steam generator with high pressure. With a reduction of the local pressure, energy savings can be obtained

The heat content of condensate, depending on the pressure of the steam from which it originates, is often large. In open steam application the condensate is not regained. The condensate is lost which requires supplementary water to be added and softened. The condensate that returns from the processes can be collected in a condensate vessel and transported from the vessel to the degassing installation, to be reused in the boiler. Condensate originating from high pressure steam can be depressurised (flashed) in a depressurising vessel and the released steam can be reused, for example in place where low pressure steam is needed, by leading it back to the boiler or by diluting it with the supply water.

When direct reuse of condensate is not possible, using (part of) the energy of the condensate for other purposes like preheating of supplementary water can be considered

6.4 Compressed air leaks

There is at least 10 places where holes can be found in the compressed air system within the factory. Compressed air leaks are significant sources of waste energy and results in excess compressor capacity. The cost of compressed air leaks is the energy cost to compress the volume of lost air from atmospheric pressure to the compressor operating pressure. A ccompany such as Bokomo that do not monitor their compressed air leakage rate tend to lose between 20 – 30% in energy for compressors. Fixing leaks within a compressed air system renders:

- Stable system pressure resulting in higher operational efficiency, and uninterrupted production.
- Reduction in energy consumption due to a reduction of compressor running time.
- Increased service life and reduced maintenance on equipment, resulting in reduced maintenance costs.

6.5 MessPack Material losses

The operator working on machine can ensure that the grippers are always properly aligned and set to the correct micrometer setting. The manual for the packaging machine states that operating pressure should be at 6 bar, but when visiting Bokomo Foods it was found that operating pressure was between 4 –6 bar for the packaging machine. Another way to combat this problem is to ensure that the gripping/suction and releasing time of the probes is set to the correct specifications. The filters of the machine can be cleaned tangentially instead of blowing compressed directly through the filter as further clogging will occur. Daily weekly and monthly maintenance should be followed according to the manual provided by the machine supplier.

6.6 Management systems

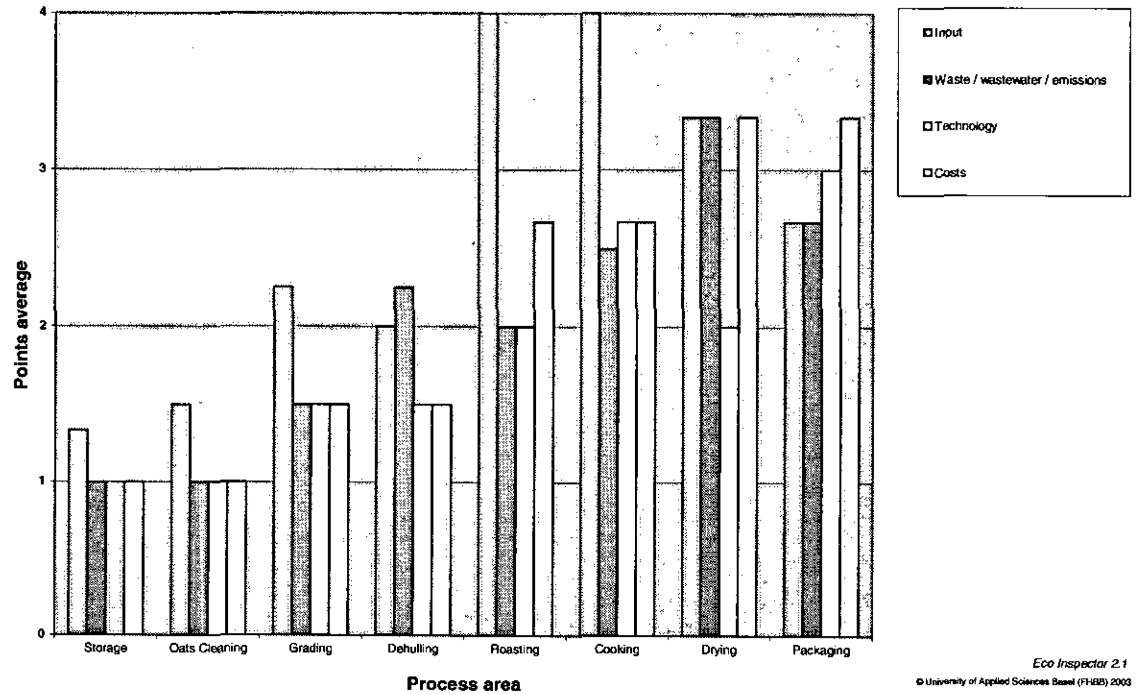
Although Bokomo Oats has a 5 star NOSA rating it is still valid to improve their systems within environment. Detailed monitoring and benchmarking will be required for all raw and auxiliary material consumption. Regular audits should be conducted and preventative maintenance scheduled for all process machinery and utilities infrastructure. Because energy is one of the highest costs at Bokomo efficiency technologies are a rapidly changing field. Bokomo should also designate a staff member to keep up with changes and consider scheduling an energy audit at least every two years.

We would recommend that Bokomo also tracks the resource usage per tonne of product for Key performance indicators. This should include all the resource inputs in order to gain a holistic view of the operation. The resource accounting system should be compiled and communicated to external and internal stakeholders. [1]

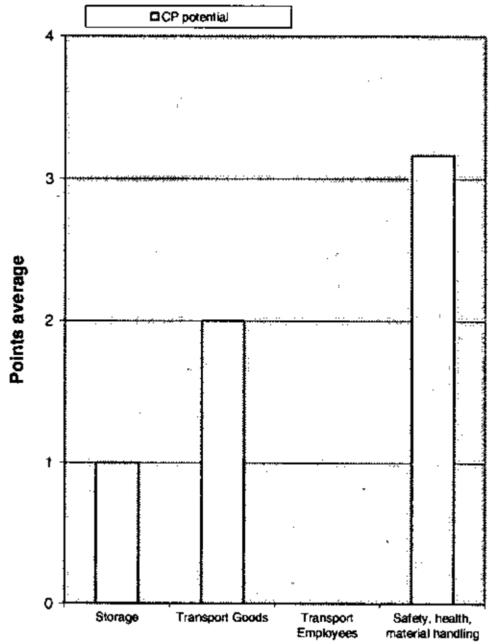
[1] This option was investigated in the previous energy report for SAB

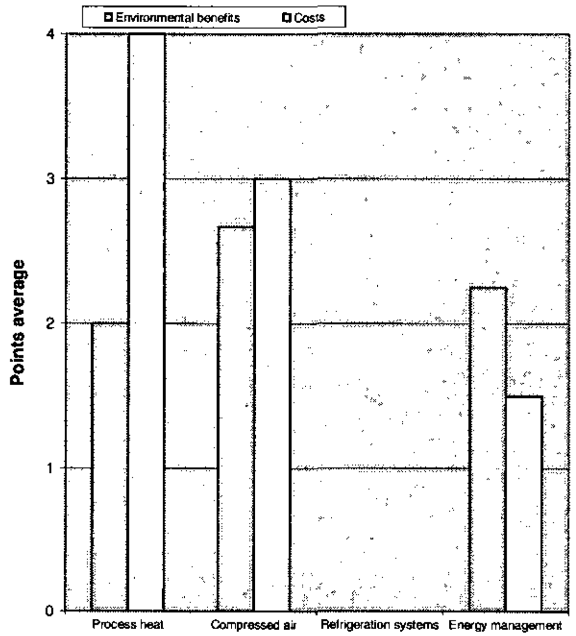
APPENDIX 1 ESTIMATED POTENTIALS OF COMPONENT PROCESSES

Bar plot of CP potentials - sub-processes I



Bar plot of CP potentials - sub-processes II





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APPENDIX 2 SUMMARY OF RESULTS

Summary of results Bokomo Oats

Process	CP potential environmental benefits (process)												CP potential economic benefits			Estimation of CP potential*			
	Input			Waste / wastewater / emissions					Technology				Costs						
	(Eco-) toxic problem materials	Raw, auxiliary, operating materials	Energy consumption	Solid waste	Special waste	Wastewater (flow, amount)	Wastewater components	Airborne emissions	Status of technology	Level of automation	Faulty batches, scrap	Maintenance, servicing, cleaning	Input materials, energy	Disposal, preparation	Maintenance, stoppages	Points average of environmental benefits (process)	Points average of economic benefits (costs)	Environmental CP potential **	Economic CP potential **
P1 Storage	1	2	1	1	-	-	-	1	-	-	-	-	1	-	-	1.2	1.0	X	X
P2 Oats Cleaning	-	2	1	1	-	-	-	1	1	-	1	-	1	-	-	1.2	1.0	X	X
P3 Grading	-	3	1.5	1.5	-	-	-	1.5	1.5	-	-	1.5	1.5	-	1.5	1.8	1.5	XX	XX
P4 Dehulling	1.5	3	1.5	3	-	-	-	1.5	1.5	-	-	1.5	1.5	1.5	1.5	1.9	1.5	XX	XX
P5 Roasting	-	4	4	2	-	-	-	2	2	-	2	2	4	2	2	2.6	2.7	XX	XX
P6 Cooking	-	4	4	2	-	2	2	4	2	2	-	4	4	2	2	2.9	2.7	XXX	XX
P7 Drying	2	4	4	4	-	2	-	4	2	2	2	2	4	4	2	2.8	3.3	XXX	XXX
P8 Packaging	2	4	2	4	2	-	-	2	-	-	4	2	4	4	2	2.8	3.3	XXX	XXX
P9 Storage	Low CP potential available for further analysis															1.0		X	
P10 Transport – Goods	Moderate CP potential anticipated. Additional analysis of goods transport system recommended.															2.0		XX	
P10 Transport – Employees	Low CP potential available for further analysis															0.0		-	
E1 Process heat	High CP potential for environmental benefits or financial savings anticipated. More detailed analysis of the process(es) 'heat provision' urgently recommended															2.0	4.0	XX	XXX
E2 Compressed air	High CP potential for environmental benefits or financial savings anticipated. More detailed analysis of 'compressed air provision' processes urgently recommended.															2.7	3.0	XX	XXX
E3 Refrigeration systems	No CP potential anticipated															0.0	0.0	-	-
E4 Energy management	Moderate CP potential for environmental benefits or financial savings. Addional analysis of the energy management system recommended.															2.3	1.5	XX	XX
Safety, health, material handling	High CP potential anticipated More detailed analysis of the safety, health and material handling aspects is urgently recommended															3.2		XXX	

* Estimation of CP potential

X	low CP potential	Points average "environmental benefits" or "economic benefits"	0.0	to	1.3
XX	moderate CP potential	Points average "environmental benefits" or "economic benefits"	1.3	to	2.7
XXX	high CP potential	Points average "environmental benefits" or "economic benefits"	2.7	to	4.0

** The value of "Process points average" corresponds to the environmental CP potential, the value of "points average of environmental benefits" corresponds to the "Economic potential"
The calculation of the points average covers all positions with a value. Positions without CP potential (value = "-") are not taken into account.

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APPENDIX 3 PRODUCTS

Company: Bokomo Created by: Zubeida Zwavel Page:

No.	Product or service / Intended use	Quantity per year	Measuring unit
1	**Oats**	1667	tonnes
2	Oats one minute	926	tonnes
3	Oats Instant	288	tonnes
4	Oats Quick Cooker	490	tonnes
5	Groats	147	tonnes
6	Oats Ground	393	tonnes
7	Oatmeal	35	tonnes
8	Oats Rolled	2 947	tonnes
9	Oats Quick Morning	2 322	tonnes
10	Meal Smash	35	tonnes
11	Real Meal	99	tonnes
	TOTAL	9667	tonnes

APPENDIX 4 THE MOST IMPORTANT TYPES OF WASTE AND EMISSIONS

Company:Bokomo Created by: Zubeida Zwavel Page:

No.	Waste and/or liquid or gaseous emissions	Quantity per year	Measuring unit	Purchase costs	Disposal costs	Total costs
1	Paper	74	tonnes	Mixed paper		
2	Plastics	33	tonnes			
4	Metal (steel)	7	tonnes			
5	Wooden pallets	unknown	?			
8	Product waste (oats) estimated	12	tonnes	R 18 000		R 18 000
9	Packaging machine (instant oats) lost revenue					**R 1 749 647**

APPENDIX 5 THE MOST IMPORTANT RAW AND PROCESS MATERIALS

Company: Created by: Page:

No.	Material	Quantity per year	Measuring unit	Unit costs	Total costs	Use	Percentage in the product
1	Oats	11 000	tonnes	R 1 500	R 16 500 000	Main raw material to produce product	100 %
2	Flavourants	unknown		unknown	unknown		
3	Additives	unknown		unknown	unknown		

APPENDIX 6 CP FOCUS AREAS

Department:
Process:
Responsibilities:

Evaluation Result: significance red

Activity Product	Aspect - normal - abnormal Operation	Environmental and Economical Impacts					overall signifi-cance traffic light			Action
		Nature	Human	Raw Material	Energy	Legal compliance				
Write the process step	**In normal use Accident or brake down**	**Impacts to flora, fauna …**	**health and safety …**	**Raw material and waste**	**Loss of heat, energy**	**Danger of non compliance**	**RED**	**ORANGE**	**GREEN**	**further assessment observation no action**
Storage oats	**Normal**	**2**	**2**	**3**	**2**	**2**			**X**	
Oats Cleaning	**Normal**	**3**	**2**	**3**	**2**	**3**			**X**	
Grading	**Normal**	**3**	**3**	**2**	**2**	**3**		**X**		
Dehulling	**Normal**	**3**	**2**	**2**	**2**	**3**		**X**		
Roasting	**Normal**	**2**	**2**	**2**	**1**	**3**	**X**			
Oats Cutting	**Normal**	**3**	**2**	**1**	**3**	**3**		**X**		
Cooking	**Normal**	**2**	**2**	**2**	**1**	**3**	**X**			
Flaking	**Normal**	**3**	**2**	**1**	**1**	**2**		**X**		
Drying	**Normal**	**2**	**2**	**1**	**1**	**2**	**X**			
Packing	**Normal**	**3**	**2**	**1**	**1**	**2**	**X**			

APPENDIX 7 WORKSHEET 8

In the table below the areas initially identified as having opportunities for implementation of CP within the production process concerned can be given. In the second column ('CP Focus') the specific part(s) on which the CP audit should concentrate should be indicated. Finally, the implementation priority and remarks about the prioritization can be stipulated.

Identified (sub-)processes with CP opportunities		CP Focus	Priority	Remarks
1.	Steam generation	The steam system needs to investigated as a high percentage is being evaporated. Some of this energy can be captured and reused in a cascading system. There are also lots of leaks in and around the processes using steam.	(H)	Savings of 10-20% of fuel cost could be saved.
2.	Messpack packaging machine	The area which generates a large amount of waste is the packaging area around the Messpack machine. This machine is not operating optimally as there are constant b breakdowns and stoppages. This is a new machine and should not operate in this way. The maintenance program should be followed strictly to avoid any major breakdowns.	(H)	The wastage on this machine could be reduced by 70%.
3.	Electricity usage	Lighting can be reduced by 50% as there is enough natural lighting for this. Peak demand monitoring should take place more frequently as 50% of the costs of the electricity is contributed to peak demand.	(H)	50% savings on lighting costs and reduced consumption of electricity
4.	Dust generation	The company has a significant amount of dust being generated through the entire process. A vacuum system for dust extraction should be considered as it interferes with operations especially in the packaging areas.	(H)	Improved health and safety and maintenance of process machinery.

APPENDIX 8 MASS AND ENERGY BALANCES FOR OPTION FINDING

Process: Name and Number							
Input		Source of information	Output			Source of information	
Name:	**Quantity**	**Value**		**Quantity**	**Balance**	**Value**	**Material left in silos**
raw material 1: Oats	11000	R 16 500 000	product 1:	9667	1333		R 1,999,500