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Reduce cost and environmental impact for handling rejected material in snus production

Master of Science Thesis

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Gothenburg, Sweden, 2012

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Cover: **Photographer:** Magnus Fond

Description: General, White, pouch, snus, star formation, 2011

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Abstract

The purpose of this paper is to examine the possibilities of increased environmentally responsibility within waste handling at Swedish Match. Also security and economical interests related to waste handling have been considered during this project. The problem at the start of this project was identified as; high handling cost for waste, low payback on valuable waste, poor security for rejected products and potential for increased environmentally responsibility.

To achieve the desired results a broad approach was taken, collecting information without restrictions at beginning. By excluding non feasible options early and narrowing down the width of solutions made it possible to put large effort into those with high potential. The findings of this paper shows the possibilities for both implementing environmentally better solutions and cost saving changes in a well developed business. Also is shown how technical solutions and new developments on the market have been utilized to achieve the goal.

The final result of the project was an implemented solution solving the stated problems. Swedish Match invested in a shredder that destroyed any products that did not meet their standards for increased security. On the waste handling side a new partner was contracted, this partner could both reduce Swedish Match's costs and implement processing methods that were more environmentally friendly. By increasing the sorting of waste at the factory and introduce better handling methods an environmentally better solution were achieved.

Keywords: Swedish Match, Snus, Shredder, Recycling, Waste handling

Preface

This report is written as part of a master's thesis within the master's program of Product Development. The thesis was written in the spring, summer and autumn of 2011 at Swedish Match factory in Kungälv.

Throughout the report there are few numbers, such as volumes, prices and savings, given. This is because these figures are company confidential, not for the public. When possible the percentage of saving or reduction has been written to supply an indication of the results.

We would like to thank the different people and companies which made the project possible.

A special thanks to our supervisor at Swedish Match, Tomas Jönsson, who has been very helpful for us throughout the whole project process. Tomas has kept the momentum of the project up and given us guidance, without his initiative this project would never have happened.

We would also like to express our gratitude to our academic supervisor at Chalmers, Professor Johan Malmqvist, who has been very helpful with compiling this report and finishing the project.

Glossary

Burnable waste – A term for waste sent for incineration, may consist of material that could be recycled if separated.

Folding container – A container made from steel of approximately 0.3 – 3 m^3 in volume. Equipped with a folding mechanism that can be released by pushing a plate in the front of the container. The container is to be lifted by a fork lift and when pushed in to a larger container the release mechanism triggers and the container folds over and empties its content. The container is also equipped with a lever for manual triggering of the mechanism.

Mini star – A smaller version of the original pouches packed in a smaller can. They are as well as the original ones packed in a star pattern exclusive to Swedish Match.

Pouch – A portioned snus, packed in a small bag. Made for easy and clean use.

SM – Short for Swedish Match.

Snus – Moist flavored tobacco powder applied under the upper lip for a period of time.

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B. Enquiry, Shredder

1. Introduction

This master thesis project aims to improve the waste handling at SM snus factory in Kungälv. In this chapter the background is described.

1.1. The company

Swedish Match is a Swedish company that develops, produces and sells market leading brands in product areas snus and snuff, other tobacco products (US mass market cigars and chewing tobacco) and lights (matches and lighters). SM sells their brands across the globe and has production units in seven countries. In 2010 the total turnover was 13.6 billion SEK and the snus stands for around 33%. Swedish Match has two snus factories in Sweden; one is located in Gothenburg and the other one in Kungälv.

1.2. Project background

The focus on the environmental issues in the society seems to be more and more important for companies. To stay competitive over time it is important to deal with these questions and demonstrate environmental improvements. The top management has decided that SM should focus more on these issues through the whole organization. At the factory in Kungälv a large potential was seen to improve the waste handling.

To maintain the high quality of the finished products that SM requires, the snus and cans are screened and some are removed from the production line due to imperfections. As a large amount of finished products is produced every day there is also enough waste created to consider the handling of it a problem.

The portion snus, the trade name for pouches, is packed in cans in a star pattern unique for Swedish match. Imperfections can be found on the pouches, in the star pattern, in the stickers glued on the cans and in the amount of tobacco mixture in each pouch. Some of these imperfections can be corrected by the operators, but when it is not possible the product is scrapped. The cans are also sometimes dropped by the robots that load them onto the lines. Sometimes entire batches of snus cans packed in cardboard boxes, ready for delivery, have to be destroyed without reaching the public because they contain secret new samples or something went wrong during production.

Figure 1: Example of pouches packed in star pattern in can.

1.3. Problem description

The problem is that today Swedish Match pays a waste handling company to transport the waste to a facility where it is burnt. This waste could potentially be lucrative. There are also the test samples and unsellable batches of snus that has to be transported with guards and destroyed for a great cost because there is no such facility to deal with it at the factory.

Another issue is the burning of potentially recyclable materials that is not in line with Swedish Match environmental policy[1]. In the policy is written: "We are committed to continue with environmental improvements and the prevention of pollution in all our activities, products and services".

1.4. Purpose

The purpose was to find new methods to recycle the different materials from the production line in a better way, both environmentally and economic. By inventorying the whole internal waste handling structure for the factory such as containers, transportations, vessels, sorting methods etc a new method should be found to handle the complete products that must be destructed in a secure and efficient way and decrease all types of emissions from handling all waste.

1.5. Goals

In summary the goal is through evaluation of different methods of taking care of rejected material from Swedish Match factory in Kungälv find the optimal solution in term of cost and in consideration to the environmental effects.

In more concrete terms the goals are to:

- Find a viable and more environmentally friendly solution for disposal of the tobacco than today's incineration at a waste burning facility.
- At the same time as utilizing a more environmentally friendly solution for disposing the tobacco it should also reduce the costs for the handling.
- Separate all material that can be recycled in a way that the material can be re-used
- Not increase the total workload of Swedish Match employees.
- Increase the positive attitude towards recycling within Swedish Match.
- Make it easy to separate the different fractions and put them in the correct vessel. In the same way make it hard to use the expensive but necessary containers for mixed waste.
- Find a secure and cost effective way of destroying the finished products.

1.6. Delimitations

Only emissions created during transportation, burning and handling the waste will be considered, no calculations for production of trucks, existing burning facilities and waste containers etc.

The work is based in the Kungälv factory and its' specific waste. The results should be possible to apply in the Gothenburg factory too if there is time, with the difference that their snus is loose and some of the cans is made of paper rather than polypropylene.

The scope of the project is the rejected material that cannot be put back in production. No efforts should be made to reduce the amount of non conforming products since this is looked into by others.

The main focus should be on the rejected material which also is the main volume of the total waste but depending on the final solution other waste may be included.

If any new fields of research needs to be explored this should mainly be done through literature studies and interviewing experts. Any experiments should only be performed if the advantages outweigh the additional time necessary.

1.7. Outline

The report is outlined in such a way that it begins with an glossary explaining certain words and terms specific for this report that may not be commonly known. Chapter 1, the introduction, consists of explanations why the project is undertaken.

In the following chapter 2, methodology, it is described the methods used throughout the project to achieve the results.

The next chapter, 3, prerequisites, explains the situation prior to the start of this project, including the different fractions and how they were handled. In the chapters following, the outline is split in the two main tracks of this report; the waste handling and the destruction of the finished products. This is done because they were treated as two separate problems during the concept phases.

Chapter 4, Problem analysis, will give a more in depth analysis of the problem to be solved.

In the concept development chapter, chapter 5, several different solutions to the problems and how they were achieved is discussed and in the concepts chapter, chapter 6, these solutions are combined into complete solutions applicable on the problem. These complete solutions are then evaluated in chapter 7; evaluation of concepts. The total solution concept is then presented in chapter 8 and then the results are compared to the goals set in chapter 10, conclusions.

Chapter 9, operational considerations, deal with possible implications and how to continue the work internally to maintain a stable, economical and environmentally friendly solution.

In chapter 11 the work is discussed regarding potential improvements in relating areas where improvements could be done that effects the goals set in this project.

The appendices included in this report are presented in their original language where only one version is available. The inquiry for the waste handling are only presented in Swedish as there were only Swedish suppliers contacted. The shredder inquiry is translated to English because of contact with companies in non Swedish speaking countries.

2. Methodology

Throughout the project the approach was to start with several ideas and then quickly dismiss those without potential, according to the figure presented below. All steps in the figure are further described below.

2.1. Funnel approach

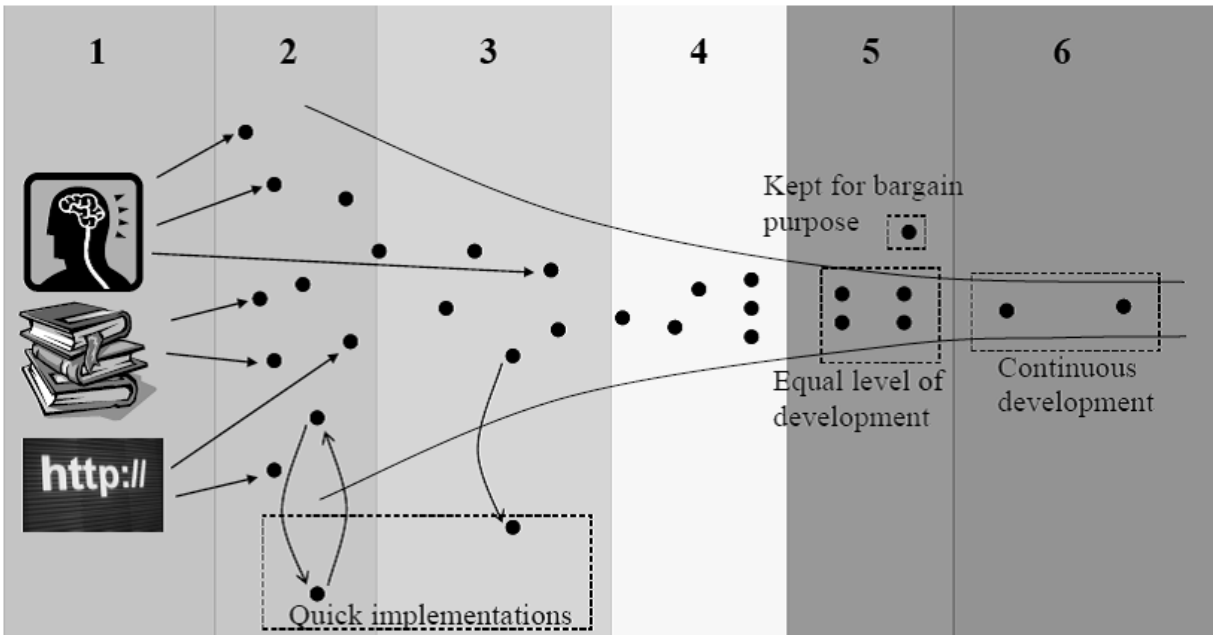

Figure 2: Mapping of the working process.

1. Throughout the project several different sources of information have been used. General information have been obtained from web pages, books and catalogues, and information of more specific nature have been obtained by talking to experts and looking through databases. The experts have been salesmen, end-users and independent professionals such as professors and lab personnel. These inputs have been used in all steps of the development but also lay the ground to the ideas to start off with.

   To generate as many ideas as possible to start off with, a brainstorming session was conducted. The session included employees from Swedish Match with different backgrounds. The goal was to, in a creative environment, create rough ideas without criticism that later could be investigated and either be scrapped or lead to a final concept.

   This approach to not exclude any initial ideas gave a good basis and an innovative environment to continue work in.
2. A quick screening of the raised ideas made it possible to exclude some ideas early without putting any more effort on them.
3. The ideas left were considered more promising and were investigated further. In this step new ideas could still be introduced or ideas combined to create a new solution.
4. In this step the final concepts were to start to shape and further testing were required to dismiss any ideas.

5. To be able to compare the remaining concepts fair they were at this stage developed to an equal level of refinement. With the development of proper evaluation tools it was then possible to choose one of these concepts to present as a final solution. Some suppliers were kept in the loop even though their solutions had been dismissed only to keep a good bargaining position towards the interesting ones.
6. The final chosen solution was continued developed and refined for optimal performance.

2.2. Process

The main steps in the process of finding better solutions was; background compiling, generating solutions, testing, comparing solutions and continue improving.

To get a general view of the problem and the potential improvements the first step in the process was to understand the situation to be improved. This was done through studying the flow of waste from the location it was produced to the waste handling supplier's treatment plant. By compiling statistics of the amount of rejected fractions and the invoices from the waste handling supplier it was possible to produce documents with calculations of potential improvements. This information was then used for dimensioning the possible solutions.

As the problem was well investigated the next step was to find solutions. These solutions were generated through internal discussions, looking at existing solutions and talking to suppliers. This resulted in several ideas for increased separation of waste and both the idea of using a shredder for increased security and a location for it.

Testing of the ideas was conducted throughout the project to exclude or to go forward with them. The testing resulted in clear prognosis of the potential of the suggested solutions.

To evaluate which solution were the best they were compared against each other. This was done both by side to side comparison of the measurable values resulting in data as well as by evaluating and weighing the non measurable values. From this comparison it was possible to choose one solution for each problem to continue work with.

The last step that was carried out a long side with the implementation was to continue the improvements, this to achieve a solution that would work in the daily routines for the employees.

2.3. Quick implementations

An important part of the project was the quick implementation of new ideas. This made it possible to early evaluate the ideas and thus dismiss or adopt them into the final product concept. This together with working very close to other people involved made it possible to get quick feedback. The work with quick implemented ideas was run parallel with evaluation of other ideas that was not possible to test as quickly.

2.4. Other considerations

To maintain benefits when discussing with players on the market, not all information have been mediated, just enough for them to solve their task. Other information has been used to bargain and discuss technical solutions internally.

There had been two previous studies conducted on a shredder for destroying finished products performed internally at Swedish Match. A shredder consists of one or several shafts equipped with knives that reduce the size of the material when feed towards them. Neither of these times they ended up investing in one because the investigated equipment was deemed insufficient and too expensive. Due to these lacks of results it was concluded that the previous reports should not form the base of this work but merely be a reference point.

The two distinctive tracks in this project, waste handling and destruction of rejected material, were treated both together and separately. Together because of their close dependency and effect on each other, also to be able to take advantage of possible business benefits. They were treated separately when the problems were isolated and the optimal solutions were looked for.

The problems this project was dealing with were not unique to Swedish Match, most companies have to take care of production waste and rejected products that are not supposed to reach the market. Therefore the main focus was to look at existing solutions rather than "reinvent the wheel". Several suppliers specialize in products and services regarding waste handling. Many of these were contacted as well as companies with relevant products and services but not explicitly in the waste business.

The end users in this project were considered very important to the final choose of concept. A dialogue was constantly kept with representatives of effected personnel, discussing proposed changes and their workload and routines. This because even if a change may be beneficial for the company, an increased workload for the end users may result in that they fell back in old routines. Then any investments done would be a waste of money.

The work was outlined in a way that the first step was to get a clear overview of the situation. This made it possible make the correct and necessary specifications to start with, especially for the enquiries sent to interesting suppliers. To shorten the development time the initial contact with potential suppliers were initiated in parallel with mapping of current situation. At this point it was not possible to specify the needs but the requirements they specified as necessary made it possibly to make a more complete inquiry.

The timeline for finalizing the final concept was depending on financing, delivery times and the length of this project.

3. Prerequisites

This chapter describes the situation of the waste handling, at the factory in Kungälv, at the time when the project was started. The different fractions of waste and the methods to handle it are discussed.

3.1. The different types of waste

At the Kungälv factory the materials that were separated from the burnable waste for other treatments were corrugated cardboard, non-rigid plastic, office paper, metals, non-burnable waste and wood. The burnable waste was the majority of the total amount of waste leaving the factory.

3.1.1. Corrugated cardboard

Corrugated cardboard consists of a fluted corrugated layer of cardboard covered on one or both sides with a flat layer of cardboard. The most corrugated cardboard comes from the packing from deliveries to the factory. This material is sorted out and is placed in designated vessels around the factory. These vessels have a volume of 660l and when they are full the logistics staffs are responsible for emptying. This took place in a big compactor container ($20m^3$) placed outdoor at the loading dock. An external supplier carries away the container for emptying when it is full.

Figure 3: Compactor for corrugated cardboard and burnable waste.

3.1.2. Cardboard

In the Gothenburg factory the cans for the loose snus is made from cardboard. When the cans are produced the leftovers are fed through a shredder and then blown directly to a compactor placed next to the loading dock.

3.1.3. Non rigid plastic

This plastic comes from packing and is sorted out and placed in designated vessels. The vessels are equipped with a transparent plastic bag. These plastic bags are compressed to a bale (weight approximately 250 kg) in a compactor, placed in the storage. These bales are placed in a big container (35m3) located behind the factory. Non-rigid plastic have a recycling value and it gives a pay back to Swedish Match from the waste handling supplier.

Figure 4: Compactor for non rigid plastic.

3.1.4. Office paper

The office paper was sorted in 190 l vessels placed around in the factory. The external supplier empties the vessels when they are full. Office paper has a recycling value and gives payback.

3.1.5. Metals

The metals were sorted in a big container (10 m^3) placed outdoor at the loading dock. This material is often related to rebuilding and maintenance in the factory. Metals give payback when they are recycled.

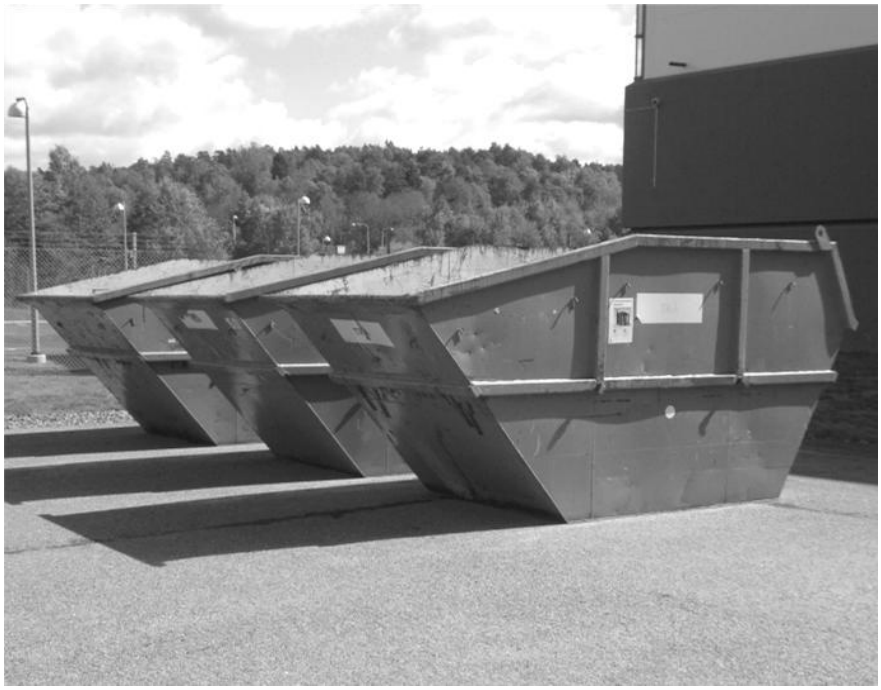

Figure 5: 10m^3 containers for wood, non burnable waste and metals.

3.1.6. Non burnable materials and wood

Big fractions of waste, non burnable materials and wood pallets were sorted in a container (35 m^3) at the loading dock. Also fractions of materials that should be sorted in other containers were found here, for example corrugated cardboard. This fraction is called unsorted waste and Swedish Match had to pay a high price, to the external supplier, for disposal.

3.1.7. Burnable waste

This fraction was the outstanding largest one at the factory in Kungälv and it came mainly from the production line. It consisted mostly of snus pouches, plastic cans and lids, and silicon paper from the labels. The waste was collected in 140l vessels equipped with a black plastic bag and placed in the production halls. These vessels were emptied in a folding container located centrally in the factory. This container with a volume of app. $2m^3$ was picked up by the forklift and brought to the loading dock where it was emptied in specific compactor container ($20m^3$) for burnable waste. Also other units at the factory as sanitation, maintenance and the kitchen personnel threw their combustible waste into this compactor.

There was also a type of waste called snus flour and it consisted of tobacco mixture that never reached the packing machine. It was poured in large cardboard boxes, app $0,6m^3$. These boxes were stored in the basement, waiting for a full truck load to be taken for destruction.

Swedish Match had to pay a relatively high price to the external supplier for disposal of this mixed material.

3.2. Finished products for destruction

Swedish Match also had to dispose of finished products that do not fulfill their high quality standards. It could be products with small defects, short expiration date, or secret test batches of new products. Depending on the high value and the risk for theft of products, they did not throw the material into the compactor for combustible waste. A security service was instead used for secure destruction of these products at a designated facility.

The products that are in need of destruction are usually already packed in boxes and arranged on pallets. Once they have been deemed unfit for sale the personnel has to rearrange the pallets because otherwise it is too high to fit into the combustion unit. They also need to wrap plastic around and store them in the basement to be able to fill up an entire truck at once. These products are being transported on pallets, on a separate truck, to a secure incineration facility. The transports are being guarded by an external security company. This method is time consuming and also very expensive depending on privacy handling. The service is also not secure, depending on inadequate feedback from the supplier.

Figure 6: Pallet of packed snus for destruction, note the height differs from the standard three layers used when sending for incineration.

3.3. Waste handling supplier

Swedish Match engages an external supplier, as mention above, to handle the waste outside the factory. They transport the containers with different fractions from Swedish Match's facility to their own plant. SM has an overall agreement with the supplier including renting of containers and compactors, transports, and treatment of the materials. Some of the containers and compactors are emptied on schedule at a specific day and other when called for emptying. Swedish Match pays the supplier for the different services and the materials that have a recycling value gives payback.

3.4. Summary

In this chapter the materials that were separated prior to this project is presented. They were; corrugated cardboard, cardboard, non rigid plastic, office paper, mixed metals, non burnable materials, wood, burnable waste and finished products for destruction. In addition to the fractions above there are small amounts of colored and uncolored glass separated in the kitchen. These fractions are some of the most common materials to recycle. The problems related to handling and separating these fractions are discussed in the next chapter.

4. Problem analysis

The problem description was a good start to focus the work on the problem area but to include all adjacent issues, it was important to study the situation. This was done by mapping the flow of the disposed materials and talking to the people involved.

4.1. Waste handling

To secure that no possible solutions were missed the problem were broken down. In the waste handling case it was not as much a problems as a lack of solutions. This due to the fact that the project was driven by the idea that it could be improved. Areas were investigated where the users were unhappy, costs were high and where it was felt more environmentally friendly solutions could be applicable.

4.1.1. The volumes

To know whether any new processing technique was feasible on any of the materials it was important to know the quantities of each material.

SM uses software that monitors all production and reports statistics based on the user's preferences. By calculating the difference between input material and output products it is possible to find out what amounts is screened out due to insufficient quality levels. These numbers together with reports from the current waste handling supplier laid out the basics for the calculations that followed. Other information needed was obtained through basic methods as; calculating, measuring and weighing.

These figures were used both to dimension the method for handling the destruction material and to find suitable solutions for waste handling with relevant pricing.

4.1.2. The problem

The problem with the waste handling was identified as: not up to date with current environmentally friendly solutions, expensive and dissatisfaction with technical solutions. Examples of technical problems are explained later in this chapter.

No more than the basic sorting of waste was performed, this included non rigid plastic, corrugated cardboard, cardboard, metals and office paper. The internal handling of waste lacked a driving force and had decayed to a low level of routine over the years.

A large container for mixed garbage had been placed at a convenient location that made it easy to dispose waste without sorting. The container for non rigid plastic had instead been placed way back of the factory in Kungälv making it fiddly to dispose of the plastic bales when needed.

Swedish Match paid monthly invoices to the waste handling company at substantial figures; this together with reports[2] that Sweden imported garbage from other companies to cover the capacity of the waste handling facilities that incinerates the waste indicated that something could be done. One simple action to take to both reduce the cost and improve the environment effects was to reduce the number of transports. After a compilation of the number transports of burnable waste and the weight of these transports was done it was easy to see the improvements that could be done. The average weights of these containers were only about

42% of the maximum weight found manageable to fill the container with during a test. With a more optimized emptying frequency the transports could be reduced by half.

The material payback and waste handling charge was neither up to date when compared to competitors in the business.

Several complaints had been made by operating personnel about service and function of the equipment and mainly the compactors. The compactor for corrugated cardboard in Kungälv was not designed for this purpose and therefore was the material difficult to handle with the machine. It resulted in manual corrections to get the material inside the compactor, a both dangerous, time consuming and unnecessary work.

4.2. Destruction of complete products

The problem with these goods is the high value. They cannot be thrown in the compactor for combustible waste, depending on theft. The products have often very small defects and can easily be sold on the black market if it falls into wrong hands. If snus that do not fulfill SM's high standard reach the consumers they can associate the products with poor quality. It is also very important that test batches of new products never reach the black market. If that happens before the release date it can give serious consequences, maybe it arrives to the competitors earlier and they plagiarize the product. In the current trend of shorter product lifecycles and increasing competition, it's extremely important to keep the new products secret until the day of release.

To use the secure destruction service is very expensive and time consuming for SM. The boxes on the pallets must be rearranged to fit into the incineration plant. The pallets are stored in the basement until 16 units has been reached, at this moment a truck is called for destruction. All this movements of the material, in the factory, is very time consuming and it also needs a lot of storage area. The truck is followed by two guards on its way to the incineration plant. The combustible service is very costly depending on the privacy guarantee. SM is not comfortable with this service depending on the lack of feedback and no evidence is shown from the destruction combustion.

4.3. Summary

Several disadvantages with current solution were distinguished and the goals for the final concept were based on solving these. The general problems are the current expensive solution, lack of environmentally efforts and suspected security issues. The evaluation of concepts discussed in the next chapter aims to solve these problems in an economical and feasible way.

5. Concept development

In this chapter the project is divided in its two main tracks; the waste handling and the destruction of finished products. It is described how the different concepts were developed and discussed about their advantages and disadvantages.

5.1. Waste handling

The key to economical payback in waste management is sorting, and the earlier you sort the waste, the easier it is. But this requires more vessels and is more time consuming than mixing all waste in one container.

After a meeting with the current supplier it was proposed that the cans and lids dropped by the robot would be collected in the same container as the non rigid plastic as this could be separated later at the suppliers' facilities and then recycled. This was a large and easy fraction to collect but the main fractions; those who made the biggest impact on both the environment and the invoices were the tobacco. At a brainstorming session together with colleagues at the office several ideas came up about what to do with it. Among the ideas was: insect pesticide, compost, incineration at the factory and incinerate as bio fuel. The idea deemed to be the most potential was the burnable bio fuel. Two incineration facilities were contacted, one local and one with permission to burn bio fuels with traces of paint etc located in Tibro, 140km northeast of Kungälv. After contact it was concluded that a fuel analysis on the material was needed. A sample of pouches was then sent to SP Technical Research Institute of Sweden for analysis. The pouches were chosen because of the pouch material could have been a problem and the idea was to test the worst scenario. If the pouches would be classified as a bio fuel then there would be no problem with the snus flour. The report[3] from SP was sent to the incineration facilities and they confirmed that they would have no legal problems burning the material, and this at a zero sum game – no cost for either transportation or handling. This because when burning bio fuels, less filters is needed and hence the process is cheaper.

To sort the pouches from the cans at the production line several different ideas was discussed; from dedicated machines to manual separation. The best idea, both economical and feasible, was deemed to be a square metal grid lowered into the waste bins. The mix of pouches and cans would be poured into the bin and after some manual shaking the pouches would fall down and the cans could be picked up and put in a separate bag.

Figure 7: Waste bin complete with sorting grid and bag for plastic cans.

With this solution at a test run in the Kungälv factory it was possible to collect enough pouches for a test incineration at the facility in Tibro. Ten ton of pouches were shipped to their facility and there mixed up with saw dust and burnt. The concerns they had at both facilities was that the amount of salt in the snus was higher than in their regular fuels. The salt could have a corrugating effect on the boiler but because of the relatively very small amounts they thought it should not be a problem. This was not something they could evaluate before they made an inspection of the boiler, and they inspect it only once a year because they then need to put out the fire and stop the production, this is usually done in the summertime. Due to this uncertainty it was decided that the enquired suppliers should offer a backup solution. Some could not find any and suggested that it should be sent for regular incineration, but others came up with ideas such as composting the tobacco or decay it to produce bio gas.

As a viable solution was obtained for the tobacco, the search for solutions for the other fractions continued. As recycling waste is best done in large scale, due to large investments in facilities and minimizing transports, the idea was to utilize the market leading companies for solutions.

In the process of introducing new suppliers to the problem it became obvious that the current contract was not up to date and had big potential of improvement. So the contract was cancelled with six month period of notice. Giving enough time to find a better deal, implement new solutions and plan the transition.

To complete a full funnel approach on the problem several suppliers were contacted both those who could deliver a complete solution and those who just solved a part of the problem. Each one of them was given the same prerequisites. This included a tour in the factory, a questionnaire (found in appendix A) with volumes and fractions, and some hints for our own ideas when needed.

When speaking to the representatives from the suppliers and when they visited the factory, they gave a good feeling about their abilities, shortcomings and professionalism. These non measurable values are as important as overall cost in such a deal when collaboration is such important.

When working together continuously it is important with a good relation between both parts. In this case the goal was to acquire a partner with whom SM could develop their environmentally work. A partner that may have quoted the lowest prices but who is not flexible may be more expensive overall when SM continues to develop their separation of waste.

The screening process did not exclude any supplier from the process but it gave a prioritizing order of the suppliers, those who were potential future partners and those who were not.

One supplier was to be chosen for the entire mission because of the obvious advantages with one part taking care of all waste. Therefore it was not possible to utilize the different suppliers' strengths, but by introducing their ideas for the other suppliers it is possible to optimize the final solution

5.2. Internal layout

Due to the specific fractions created at the factories and the importance of separating the fractions in their designated vessels it was thought that specific, internal, decals should be produced. Clear and simple to understand decals would ease the sorting, promote environmentally work and be in line with Swedish Match's 5S policy. The new decals will be standardized with SM colors and fonts, each fraction will be allocated one specific color, both for small vessels and large containers. This way you would only need to look for the correct color, once you learnt the system to dispose of the waste.

Throughout the factories SM has implemented 5S, a methodology for workplace organization. The five phases of 5S is: sorting, straightening, systematic cleaning, standardization, and sustaining. With clear positioning of the vessels, clear messages and standardized layout, many of the S:s can be achieved.

On the decals it will be a picture of the fraction to be disposed in the vessel, large areas with the designated color, a text shortly explaining what will happen to the fraction, examples of what should be disposed, what not to be, and contact information if questions would occur.

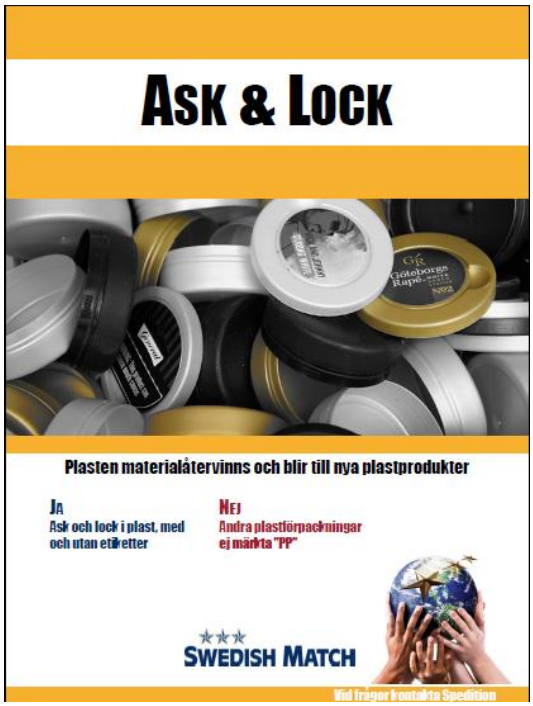

Figure 8: Decal showing that this is where to sort the cans (in Swedish; Ask) and lids (in Swedish; Lock); it explains what happens to the plastic afterwards and gives examples of what to dispose here and what not to.

Together with most of the suppliers it was suggested that instead of a mobile compactor, as used today, a stationary compactor should be used for the cardboard in the Gothenburg factory. A stationary compactor consists of two parts, the compactor unit and the container. The compactor unit is stationary and only the container is brought when full. This gives the advantage that waste can be disposed even during emptying of the container. They are more expensive than mobile ones and because of the larger capacity of the stationary compactor it is not always possible to utilize the full capacity because it will then be too heavy for the truck if used with high density waste.

Together with new, clean vessels and a general brush-up of the sorting areas this would awaken the people involved and hopefully encourage them to work for better recycling and environmentally better solutions daily. This would be a condition for all proposed changes to succeed.

5.3. Destruction of complete products

From a brainstorming session two main categories was generated; destroy the products direct at the factory or sell the snus in a second hand shop. Put the destruction products on the market to a lower price is not appropriate from many aspects. Snus that does not reach the high quality standards should not be related with SM, it can damage the brand. Test batches of new products cannot be selling before the release. The tobacco taxes and regulations can also be a problem in such business. Depending on that, the idea of a second hand store for snus was abandoned. It was found that destruction of the products at SM's own factory should be the best solution. That would give the highest security and generate direct feedback to the process.

5.3.1. Destruction at the own factory

Also here was two main ides generated, destroy the products by using a machine or do it by hand. From a short analysis, it was understood that manual destruction was not suitable, depending on it would be too time consuming. Also a high degree of demolition, which is important for new secret products, would be hard to reach when no tools are available for this mission. The warehouse workers do not have the time for manual destruction and to employ someone for this job would be very expensive. A machine for the destructions process was seen as most appropriate.

5.3.2. Shredders

The most common machine to use when to grind materials is a shredder. It is applied in a wide range of industries when the media size should be reduced. An example is in recycling industry were materials such as wood, paper, metal, plastic etc is grinded to smaller sizes, as the first step in the recycling process. There is a wide range of shredders available on the market.

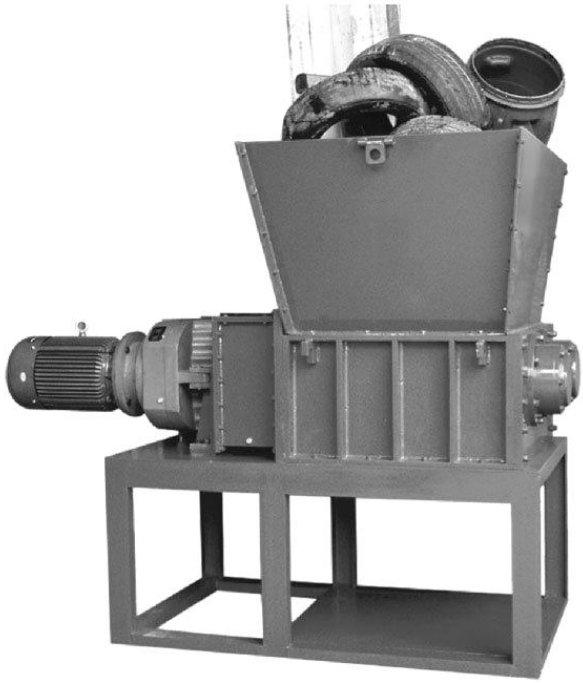

Figure 9: Typical two shaft shredder.

A shredder has usually 1-4 rotors depending on the construction. The rotors are equipped with cutter blades that cut against a fence or each other when it is rotating. A shredder also often has a pusher that presses the material against the rotors when the machine is processing. These components are mounted in a chassis with a hoper on the top, were the material can be loaded. Under the rotors is a grid mounted, the dimension of the holes in the grid regulates the size of the material fractions that exits the shredder. Because of these previous problems it was specifically specified in the requirements list that the machine should be able to grind all types of snus without it sticking.

5.3.3. Previous studies

Some years ago SM did a pilot study about shredders for destruction of their own snus products. The project and the investment were discontinued when they did not found a satisfying machine regarding price and function. From some test drives of shredders it was shown that the loose snus was a big problem, depending on its texture, it caused flow blockage in the machine.

5.3.4. List of requirements

A list of basic requirements was created for the shredder.

- The shredder should be able to grind both portion and loose snus packed in boxes containing 240 cans and also production waste (snus pouches, cans, silicon paper etc) packed in 200 liter plastic bags.
- Hoper volume $2m^3$ and 1500 mm wide (The volume of the folding container in the factory, for the plastic bags with production waste, is $2m^3$. One pallet with snus boxes has a volume of 1.5m3).
- The grinded materials should be transported to the compactor for combustible waste
- Grind capacity: 1000 kg/hour.
- Max size of grinded material 30 mm in diameter (This size ensures that the product is completely destroyed).
- The hoper must be 1100mm over the loading dock (law regulations, no human should be able to fall into the machine by mistake).
- Max width of the machine 3000 mm (limited space in front of the loading dock)
- Built for outdoor conditions.

5.3.5. Suppliers inquiry

Eight different suppliers working with shredders were contacted by phone. The situation, conditions and the requirements were described for the machine. Four of these suppliers considered that they had the right equipment for this purpose. Representatives from these companies visited the factory, in Kungälv, to see the situation in reality. Different solutions were discussed with focus on functionality, performance and space/area needed.

After the visits from the suppliers and discussions, additional requirements were identified. The best place to install the shredder was found in front of the loading dock. That is because it has to stand close to the compactor for burnable waste for easy transportation of the grounded material to the compactor and also be easy to load with material by the forklift. The space is limited and depending on that a max width of 3000 mm was decided for the shredder equipment.

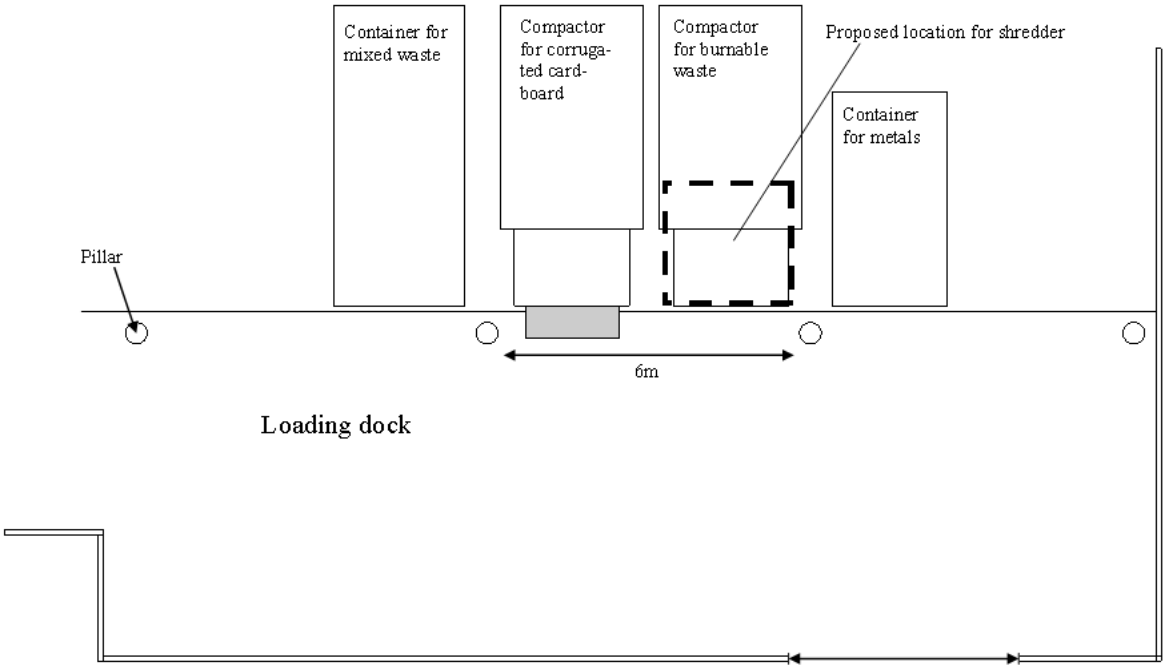

Figure 10: Drawing of the loading dock prior to the project.

5.3.6. Request for tender

A request basis (found in appendix B) for a shredder solution was developed and sent to the four suppliers of interest. The document included all the requirements from Swedish Match regarding the machine. The quotation from the supplier should contain: Technical description, drawings, specified price list, service cost over 10 years, delivery time etc. The last date for the tender, incoming to Swedish Match, was June 15, 2011.

5.4. Summary

During the concept development phase, different partial solution elements were identified for the problems. The first element was the solution for taking care of the tobacco. It was decided that the tobacco were to be burnt at a bio powered plant as a bio fuel. The second element was taking care of the rejected finished products. It was found that the best way to destroy these was by shredding them in a shredder. A part from these two largest changes several solutions were obtained to solve the other, less eminent problems.

6. Concepts

By combining the different solutions studied in the previous chapter some desired concepts were put together. This chapter would correspond to step five in figure 2, in chapter 2, the remaining interesting concepts are being developed to an equal level of refinement. This is done to not exclude any supplier due to lack of investigation. There were still other solutions kept that were not of interest, just to be able to play the suppliers against each other.

6.1. Waste handling

The final concept for the waste handling consists of one supplier managing all fractions of waste in the factory; this includes vessels, transportation and processing except for the tobacco that is burnt at a local bio powered power plant if the testing turns out fine. The supplier would however manage the transports of the loaded containers to the power plant and leasing of said container. The suppliers solutions were all adapted to our demands and hence were the quoted solutions very similar in the technical aspect. The differences were found in prices, equipment and cooperativeness.

At the factory the following fractions would then, at first, be separated for processing by the supplier:

- Wood
- Paper
- Non rigid plastic
- Polypropylene plastic
- Pouches and snus flour
- Corrugated cardboard
- Cardboard
- Mixed Metal
- Stainless Steel
- Aluminum
- Copper
- Cables
- Electronics
- Burnable waste
- Mixed waste

All these fractions will be material recycled except for pouches, snus flour and the burnable waste that will be recycled for energy recovery and a small amount of mixed waste that will be sorted and dealt with in a proper way.

The corrugated cardboard from the boxes in which the tobacco is delivered, were at first thought to be sorted separately due to that the high quality virgin material they are made from is more valuable than standard quality. But due to difficulties finding space for one more container it was decided that all corrugated cardboard were to be mixed up with the normal cardboard. This would give a lower payback but overall the savings would be greater compared to making space for one more container and the rent for this.

The fractions would be handled in by the supplier suggested containers for transportation. Internal collection would be done using a combination of existing vessels owned by SM and by the supplier supplied vessels.

Following the transition to the new work flow, all sorting areas should be looked over and be well advertised. Included in the transition is a short presentation and education in the new workflow for all personnel. The people directly involved in the logistics will be getting a more in depth presentation.

6.2. Shredder

Four different suppliers presented their own solution with a shredder and associated equipment. All machines are powered by electric motors.

6.2.1. Supplier 1

This is a single shaft shredder with an integrated pusher. On the top there is a big and wide hoper mounted, easy to load from the dock. The machine has two transporters, in form of screws, assembled on each side. Containers for the grinded material should be placed under the outlet of the screws. By a switch the operator can choose which container should be loaded by grinded material. Depending on the vertical transporters the total solutions is slim. The shredder can handle material pieces max 1400 mm wide.

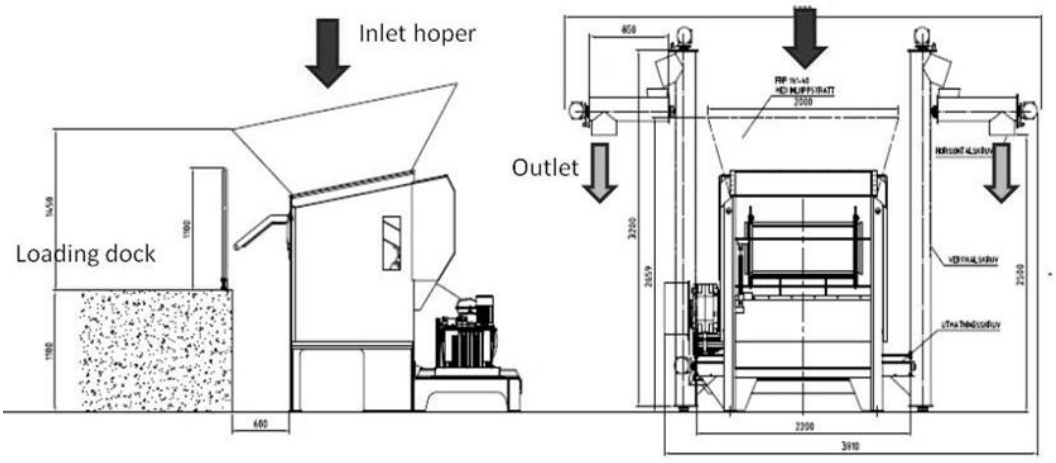

Figure 11: Drawing of supplier 1's solution.

6.2.2. Supplier 2

This is a single shaft shredder with integrated pusher and also equipped with a hoper on the top. This machine is designed with a band transporter placed behind the shredder. Here should the container for the grinded material be placed behind the machine, compared with supplier one where the containers should be placed next to the shredder and the loading dock. The machine can grind materials with max width of 1200 mm.

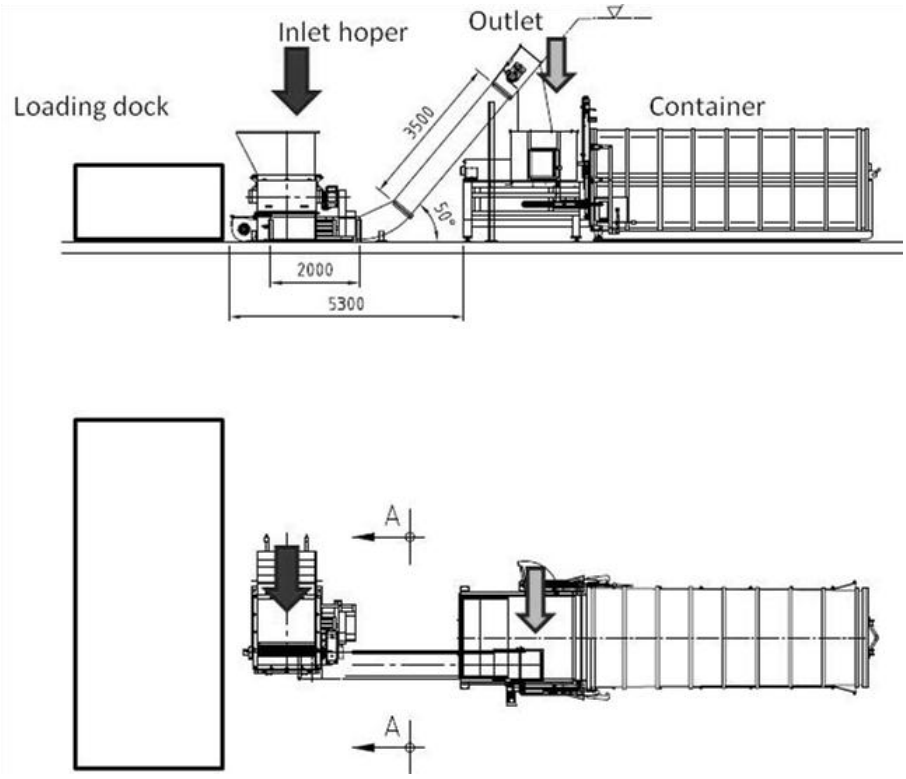

Figure 12: Drawing of supplier 2's solution.

6.2.3. Supplier 3

This shredder has three shafts working together. The machine has no pusher, instead should the material fall down to the rotors by itself. The cutting blades will grab the materials and press it against the rotors. This solution has an air system to transport the grinded material from the shredder to the container. Over the container should a separator be mounted on a frame and behind the shredder is the vacuum engine placed. The machine can grind materials with max width of 700 mm.

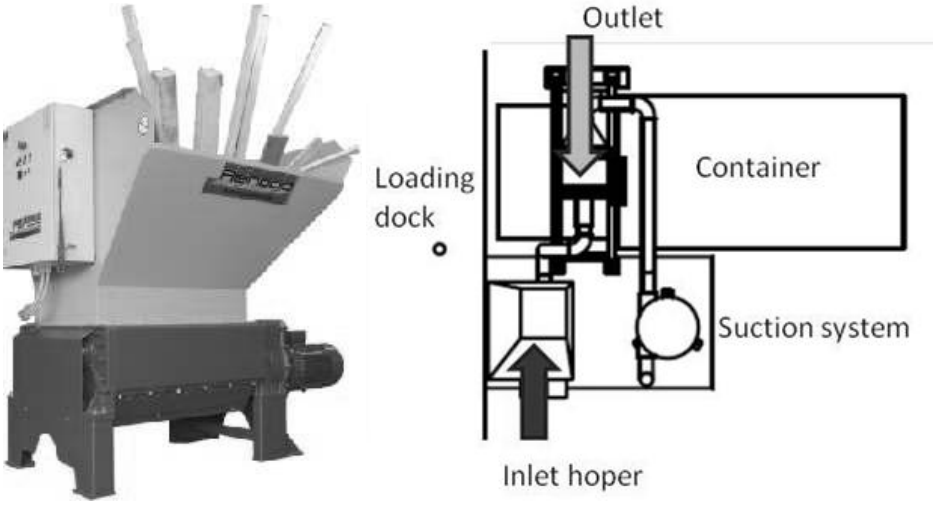

Figure 13: Drawing of supplier 3's solution.

6.2.4. Supplier 4

This shredder has four shafts working together. A pusher is mounted on the top of the machine behind the hoper. The transporter has the same solution as the machine from supplier 1 (The transporter is not mounted on the shredder in the drawing below). This equipment should be place in the same way, in front of the loading dock, as supplier 1. The machine can grind materials with max width of 1000 mm

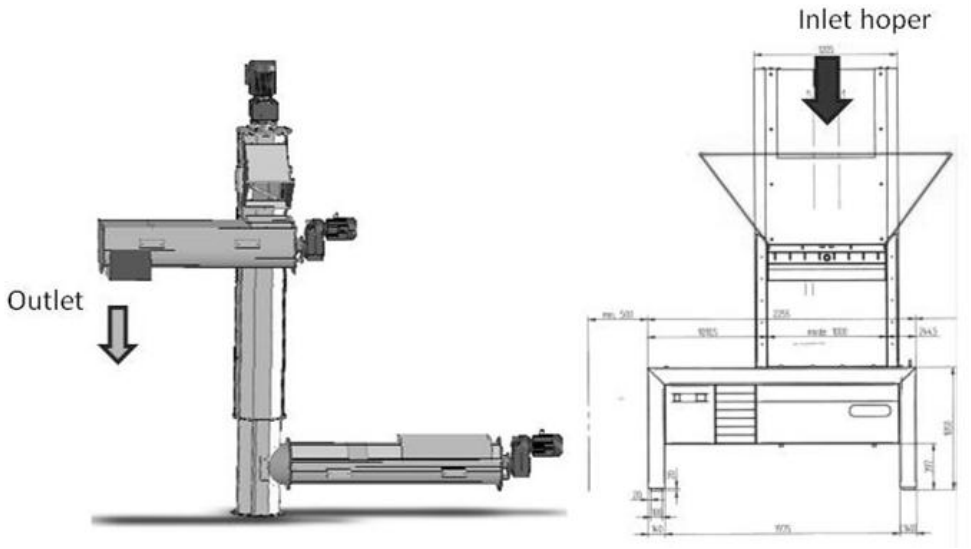

Figure 14: Drawing of supplier 4's solution.

7. Evaluation of concepts

Once all the questions were answered by developing the remaining concepts they could be evaluated and compared against each other.

7.1. Waste handling

As the waste handling were to be handled by one company it was necessary to compare the supplier's solutions according to some categories to get a solid decision basis.

7.1.1. Categories

The suppliers were judged in three prioritized categories; cost, proposed solutions and collaboration. The cost was easily comparable through a scenario described below but their solutions and willingness to create a functional partnership could not be measured with numbers.

The aspiration was environmentally friendly solutions when the economical drawbacks were defendable. To measure this without extensive and costly investigation required this was judged from a "customer" perspective. How good for the environment each solution was in case of for example carbon dioxide emissions does not matter if it is not obvious for the shareholders, customers and employees. The real economical benefits of environmental work for Swedish Match are when it is mediated to these groups. The, by the customer, perceived environmentally benefits are more important than the measurable and therefore the solutions that were easiest to mediate and gave a strong connection to environmentally responsibility were chosen.

To determine how cooperative the suppliers would be in a future relationship they were judged based on their impression from meetings and questions about future development of the collaboration.

7.1.2. Cost evaluation

As the contacted companies handed in their quotes a method to compare these were needed. The quotes were all different as both their solutions were different and they charge differently.

To compare "apples with apples", a scenario was made. The scenario consisted of an estimated volume of the different types of waste for the year to come and a general solution for the quantity and types of containers. It also included an estimation of the number of transports needed. Together with the quotes, the scenario would present a total cost of each offer under similar circumstances. These figures together with non quantifiable pros and cons lay the ground for the decision making

7.1.3. The scenario

The quantities of the different types of waste were based on the numbers that were calculated for the enquiry. The number of pickups was calculated by dividing the total weight per year by the weight of an average full container of the specified type.

In the scenario the number and types of containers are based on both the current supply and the improvements suggested in the quotes. They were combined to a solution that was supported by all the companies that were compared.

To simplify the process, some marginal costs were ignored. These costs, such as rent of small vessels and processing costs for low volume garbage did not have any ruling effect on the overall cost.

As the idea of burning the tobacco as bio fuel was evaluated for one year it was needed to calculate the results for a backup solutions too. Two results were presented, one where the tobacco were disposed at a zero sum game and one where calculations were based on the suppliers own best solution.

7.1.4. Transportation concerns

One concern taken into account was when the separated pouches and snus flour were to be transported during cold weather. With temperatures below zero degrees they risk freeze together and stick to the surface of the container. To evaluate this potential problem an experiment was conducted. Smaller batches, approximately 200g, of loose snus and pouches were packed in small metal containers, put in plastic bags, and left in the freezer at -23C over night. When examined there were no signs of freezing of the snus. Neither was it stuck to the metal container. This was expected due to the levels of salt in the snus preventing the water to freeze.

7.1.5. Results

When concluded, all prices from the quotes could be filled in the scenario and a total cost for a year was presented, a cost that could be easily compared. Some uncertainties remained though, the payback of the shredded polypropylene and the processing cost of the snus and snus flour were not certain at the time.

During the evaluation an unforeseen problem occurred at the bio power plant and they decided to end the trial. The problem was not specified in detail but the feeling gained from the decision was that there were several reasons for aborting. The gain for the power plant was not much and maybe due to the slightly controversially product tobacco is they did not want to continue the cooperation. It was then decided that the backup plan were to be used for the tobacco. The chosen supplier’s backup plan was to mix up the tobacco with other biological waste and compost it.

None of the suppliers could give a definitive answer on the payback of the polypropylene because it depended on if the cans were reduced in size and how it could be collected. The payback on the polypropylene would increase from all suppliers if it could be delivered shredded therefore it was decided to look into the possibility to shred it in the shredder for destroying finished products.

7.1.6. Pouches and can separation

As the grids mounted in the trash cans had been used a couple of weeks a questionnaire was passed out among the operators. The purpose was to evaluate both the design of the grid, the workload of the operators due to the sorting and their general opinion about increased environmentally work.

Even though the responses from the survey were few it was deemed to be the best way to get the opinions from the operators. The general response was very good, 95% of the responders thought the design with the grid inside the bin was good or very good. Only 5% thought the design was not good or not good at all. Among the comments it was common with ideas of improvement of the grid. The most common was to extend the grid all the way to the inside of the bin to eliminate the small chance of a can to fall between and to make the holes in the grid larger to make it easier for the pouches to pass through.

7.2. Shredder

The shredders and the total solutions for destroying finished products were compared against each other. Two suppliers were selected for further investigation.

7.2.1. Supplier 1

The shredder has a slim and satisfying transporter system that can load 2 different containers. The machine has the largest hoper and that is good for the loading process. The equipment is produced in Sweden and that is good for easy communication and service. The shredder also has the biggest rotor and can grind material up to 1400mm. Decision was made to work further with this supplier.

7.2.2. Supplier 2

With this solution a big problem was found when the container for the waste should be placed behind the shredder. There is also a desire to reach the container from the loading dock when materials should be thrown into the container without passing the shredder. This solution also was the most expensive and had highest service cost. Decision was made to not work further with this supplier.

7.2.3. Supplier 3

With this equipment similar problem was found about limited access to the container for combustible waste. The frame and the separator blocked the inlet to the container. The air systems was also considered complex and the functionality was uncertain. The shredder was not equipped with a pusher and suspicion about flow stop in the hoper arose. Decision was made to not work further with this supplier.

7.2.4. Supplier 4

This shredder has four shafts working together under the grinding process. A pusher is mounted on the top of the machine behind the hoper. The transporter is very slim, equivalent with the equipment from supplier 1, but only one container can be loaded. The shredder should be placed in front of the loading dock also equivalent with the solution of supplier 1. Decision was made to work further with this supplier.

7.2.5. Test drive

Test drives were performed to ensure that the shredders from supplier 1 and 4 could grind snus without problem. During the session equivalent machines, as the supplier offered, were tested.

7.2.5.1. One shaft shredder, supplier 1

To evaluate the first choice of shredder properly a trip to the manufacturer's facilities was undertaken. To make the test as realistic as possible without the possibility to bring as much material as preferably, a representative choice of snus and cans were brought. One double pallet with loose snus, packed ready for delivery, one big box with bags full of production waste, one equally big box full of cans and lids, and one pallet with mini star packed snus was brought.

The loose snus were brought to evaluate any possible problems with snus jamming up the teeth in the rotor. The bags were brought to make sure that they wouldn't jam the funnel, and the mini star to make sure the screen size wouldn't allow any non destroyed products to pass.

The manufacturer had a shredder of the same model like the one of interest to us but with the difference that the rotor was not adapted to moist and sticky materials. All other relevant specifications were up to our requirements. The shredder was installed at their factory complete with feeder and conveyor belt for transporting the shredded material.

Figure 15: Picture of shredder from supplier 1 at test run.

7.2.5.1.1. Results

Several boxes of snus cans were feed into the shredder, before it was turned on, to simulate a simultaneous emptying of a pallet with snus. The machine ground the different types of snus and packages without problem. The size of the material after the process was satisfying, 0-30 mm in diameter and the ministar cans were destroyed by the shredder. The sound level during the test differed depending on the material shredded between 70 and 85dB. These levels are acceptable and would not disturb other activities at the factory.

Figure 16: Picture of snus shredded by supplier 1's shredder.

Some problem arose with snus material stuck on the knives in the shredder. That was expected according to the supplier depending on the snus material with high moist. In the quote to SM they recommended a bio-rotor designed for these types of material to avoid this problem.

Figure 17: Picture of material stuck on the knives on supplier 1's shredder.

A test with only plastic (cans and lids) was performed. The purpose was to reduce the volume to increase the profitability when recycling the materials. Higher densities reduce the transportation cost and increase the payback for the plastic. First a wood pallet was ground in the shredder to clean the rotor from moist snus. After that the plastic was thrown into the hoper. The grinding processes reduced the volume to about 1/3 and that was satisfying.

Figure 18: Picture of cans and lids shredder by supplier 1's shredder.

7.2.5.2. Four shaft shredder, supplier 4

The supplier had a test unit mounted on a hook lift platform. This unit was delivered to Swedish Match factory in Kungälv for testing one entire day. The model of the unit was very similar to the one recommended by the salesman to suit our demands but with some differences. The knives on this test unit was 29mm wide, with the smallest cans with a thickness of only 19mm this could be a problem. The machine also lacked a screen, making it possible for large pieces passing through the shredder and the pushers on this specific model was adapted for pushing and shredding mattresses. These weaknesses were known before testing but it was deemed that the physical testing would provide relevant information none the less. The shredder was equipped with a hopper approximately 2,5m wide, 1,5m deep and 1,5m high with sloping sides, making the total volume of about $2m^3$.

To evaluate the shredder several pallets of portioned snus boxes were available but to make a proper evaluation and investigate any eventually differences, a pallet of loose snus was delivered from the Gothenburg factory. The portioned snus was packed in both standard sized cans and the new mini can.

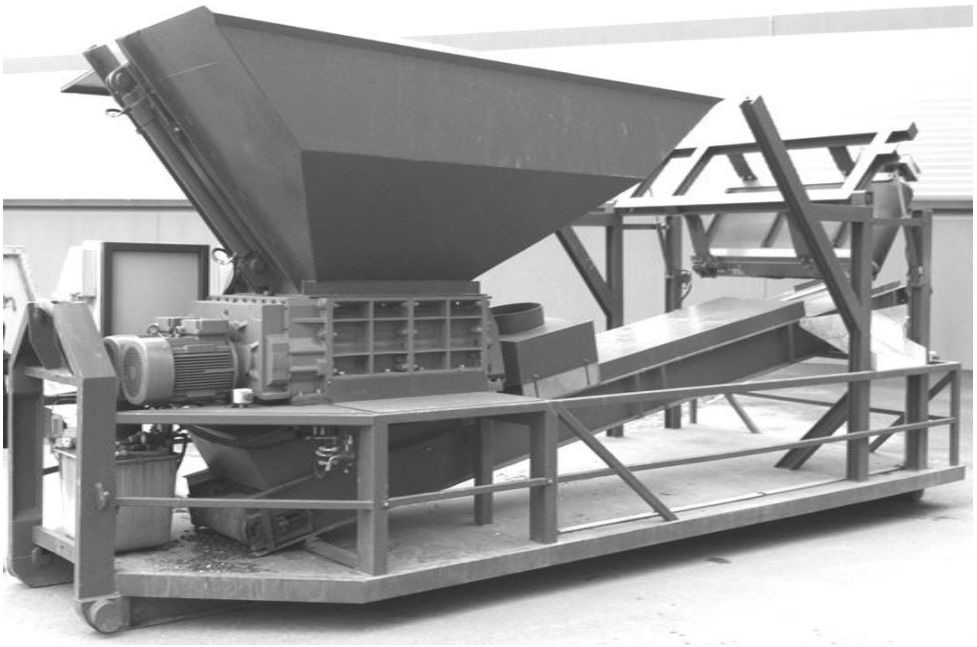

Figure 19: Picture of shredder from supplier 4.

7.2.5.2.1. Results

The startup and running of the shredder was successful. Overall 36 pallets of snus were destroyed. None of the snus stuck to the machine, the loose snus was due to its higher snus to can ratio, moister, but no buildup in the machine could be seen what so ever. On the conveyer belt there was on the other hand some buildup of snus. This layer could be scraped off with a shovel so a fixed plate touching the belt could minimize this problem.

The dimensions of the knives and the lack of screen lead to quite large pieces, especially of the cans. Some of the cans came through in one piece.

Figure 20: Picture of snus shredded by supplier 4's shredder.

7.2.6. Evaluation and choice of shredder

Both the shredders have the function to grind all the different products and materials that SM requires, in a good way. When the equipment and total solution, offered from supplier 1 and 4 was compared against each other, alternative 1 was the outstanding best.

The shredder from supplier 1 has a wider rotor and can handle larger fractions, for example pallets. The hopper is also wider and easier to load. One shaft shredder is cheaper from a service perspective compared with a four shaft machine. Supplier 1´s solution has more flexible transporter that can load two different containers. Advantage was also seen from the perspective that the shredder is manufactured in Sweden. That is positive for good communication and fast delivery of spare parts.

7.2.7. Further development

When the final supplier was chosen a work started do improve the functionality further to make sure the solution was well thought thru when delivered. The space in front of the loading dock is limited. A new idea arose to have one container beside and one behind the shredder, instead to have two containers on each side of the shredder. A new transporter was developed with an adjustable arm. It can be turned between two different containers depending on the material that should be grinded. This solution uses the space behind the shredder and release space next to the loading dock.

8. Total solution concept

Through the evaluation it was possible to pin out one supplier for the waste handling and one for the shredder that were outstanding compared to the rest. A side of the contracted suppliers several internal changes were planned to be implemented to be able to achieve the set goals.

8.1. Waste handling

Through tough evaluation a concept that would save money, increase security and reduce the environmentally impact was presented. The concept included increased separation at source, changing of supplier, brushed up internal management and sending the tobacco for composting.

8.1.1. Separation

The increased separation is a precondition for saving money and recycling. The difference to before the project is that the pouches are separated from the cans, common metals are separated, polypropylene is collected separately and the virgin corrugated cardboard is collected together with the regular corrugated cardboard and the cardboard. To achieve this, new vessels needed to be located conveniently and designed for the purpose. The pouch separation will be achieved with a redesigned grid, eliminating the previous drawbacks from the prototypes. The grid will cover the entire opening to prevent any cans from falling between and the vessels will also have an increased volume to make it easier to emptying the mixed waste for separation. This together with larger holes in the mesh will decrease the time for sorting and increase the purity of the fractions. Designated vessels for the metals and plastic will increase the will to sort; it should be easier to sort out the fractions than to dispose of it in a mixed container.

8.1.2. Change of supplier

The new supplier will, apart from cutting costs, also be an incentive for continuous environmentally work. This by offering solutions for treatment for new fractions not separated today, follow ups and education for the employees. The idea is that, even if no increased separation will occur, at least today levels of effort will not deteriorate.

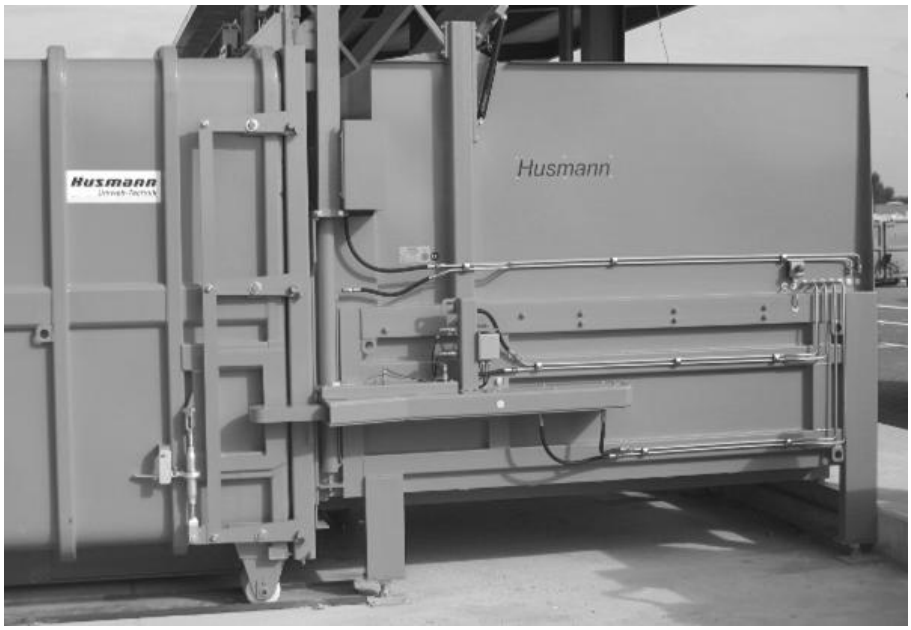

Figure 21: Example of stationary compactor with attached container.

8.1.3. Brush up

A new standard for internal decals and dedicated waste handling stations at convenient locations is to be introduced. This will show the personnel that it is important with environmental work within Swedish Match. Hopefully this will be an incentive for sorting the waste. The decals will be designed as earlier described and the stations will be laid out in collaboration with the new supplier.

8.1.4. Compost

The new contracted supplier's backup plan for the tobacco was to make soil out of the tobacco, this by mixing it with other bio waste. This solution is more expensive than the original plan to burn it, but far cheaper than sending it off to normal waste incineration. It also is a more environmentally friendly solution and because large parts of the snus are made from plants it is a very natural solution.

8.1.5. Transportation

To reduce the number of transports from the factories it was decided to go for an automatic respond system on the compactors. This system registers the force needed to compact the waste and when a certain level is reached it sends an SMS to the supplier saying that it is ready to be collected. The system will be calibrated to work together with the suppliers lead time so when the truck arrives the compactor will be as full as possible.

8.2. Shredder

The final solution consists of a shredder with one shaft. The rotor is designed for moist material to eliminate snus sticking on the knives. The machine has an integrated pusher with programmable movements to make the grinding process more efficient. On the top of the shredder is a big hoper mounted with a volume of $2m^2$. The hopper is two meters wide and easy to load by the forklift driver. The screens under the shredder have holes with 30 mm in diameter, which means; no ground material larger than that can leave the shredder.

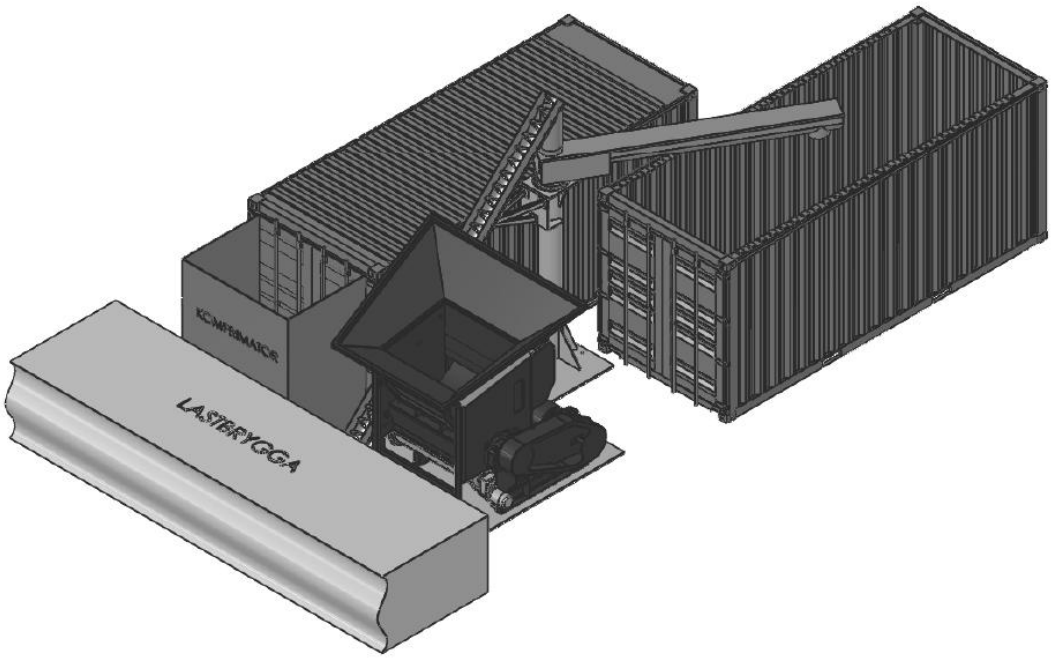

Figure 22: Rendering of complete solution with shredder and transportations system.

The shredder is placed in front of the loading dock. On the left side is the container for combustible waste and in front of the shredder is a container for plastic located. The transporting system consists of feed screws mounted on the left side of the shredder. The top screw swivels 180 degrees between the two different containers

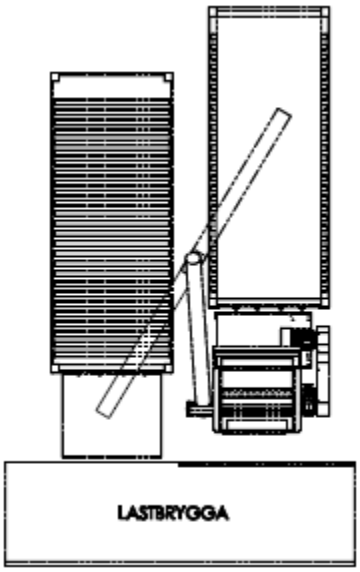

Figure 23: Drawing of complete solution with shredder and transportation system.

The motion of the top screw is powered by an electric motor. The equipment is regulated from a control unit placed on the wall next to the loading dock, easy to reach for the forklift driver. Depending on material that should be shredded can the operator, by a switch, choose container for loading.

Complete snus products for destruction can now be destroyed in the shredder instead of using, as before, the privacy service by the external supplier. When the snus products are ground by the shredder is it classified as normal combustible waste. To destroy the products direct at the factory is considered very secure by SM. The logistic work with all the moving of pallets to the basement and rearranging of boxes is eliminated and saves a lot of time. The new method, with a shredder, also save a lot of money depending on that the privacy destruction service was very expensive. When the plastic (cans and lids) is grinded the volume will be reduced. That decreases the transportation cost and also increase the payback.

9. Operational considerations

When the concept is implemented there are some things to consider. It is important to get a working transition to eliminate any sources of negative feedback. Any negative experience during this process may reflect on the experience of the new concept.

9.1. Workload

Even though the total amount of work is calculated to drop for those working in logistics they might find the new tasks as a greater load. An observation is that people tend to quickly set into habits and respond negatively when things changes, even if they result in a lower total work load. Any such complaints should be responded with a clear explanation of the benefits, both economical and environmentally, that justifies the work.

9.2. Complexity

The more choices we have the more risks we have to do wrong. It will be important to use the right bins for the right garbage and keep it free of contaminations. The recommendation to achieve this is to clearly mark all vessels and areas as soon as the vessels are placed in their right position.

9.3. Logistics

With so many different fraction and destinations it is important that the logistics works. Snus for destruction should be sent from Gothenburg factory to Kungälv, where the shredder is located, and if possible use trucks with free space to minimize the costs. Once these trucks arrive in Kungälv it is also important that there are personnel with time to take care of the pallets. Otherwise they have to spend time to move them down to the basement in time for when they have possibility to shred them and then move them right back up again. This would result in an increased workload.

9.4. Responsibility

People must feel responsible for their areas, this includes making sure it works, working with improvements and report if something is not working. Without responsibility it might be hard to motivate people to do something that at first glance seem to increase their work load.

9.5. Continue work

Do not stop with these improvements, continuing with improvements is important both for PR and the motivation of those working with it. This work is not something to be repeated every tenth year but should be involved in everyone's daily routine. This way it is possible to always be up to date with new solutions and keeping the pollutions down at a minimum.

9.6. Equal prerequisites

Keeping high standards at all areas minimizes the risk of someone setting a bad example for others to take after. This means everyone; from kitchen and sanitations to office workers and operators has the same demands on sorting, by them, produced waste. But having these demands without the same prerequisites may lead to complaints. If different demands are put upon different people it is important to explain the differences in conditions that's been applied while work is undergone to equalize this.

10. Conclusions

The result of the project fulfills the stated goals to reduce the cost and environmentally impact.

In the production cans and pouches are now separated to minimize the mixed combustible waste. The operators use a grid, placed in a vessel, were the pouches falling through but not the cans. Also rejected cans and lids from other areas in the factory are placed in designated vessels. The separated plastic can now be recycled to new products and the materials gives payback to SM. Before the project this plastic was combusted for a great cost which also cause CO_2 emissions.

The pouches and the snus flour are mixed with other biological materials for composting (by an external supplier). The soil can be used as restorative materials for road construction as an example. Composting the material is better from an environmental aspect compare to combustion were CO_2 is released and the method is also cheaper.

A new shredder was acquired to destroy the complete products, not approved for the market, directly at the factory. When the ground snus products have left the shredder the material has a size between 0-30 mm. A screw transporter moves the material from the shredder to the compactor for combustible waste. Destroying the products at the facility gives SM full control over the process and it is regarded as very secure. The ground materials is classified as combustible waste and that results in a much lower cost compare to use a safety incineration service from an external supplier.

A new procurement for the waste handling was made. That included renting of container, transportations and treatment of the materials. Five different suppliers were invited for negotiation to present their services. Finally one company was contracted who offer the best solution regarding price, service and environmental aspects.

Continuous information to the employees about the project had raised the knowledge and interest for environmental issues. A new internal color standard for the vessels' signs has been developed for SM own different specific materials. That makes it easier to sort the fractions and increase the awareness.

11. Discussion

Throughout the project several areas has been touched upon relating to the waste handling. This discussion chapter will reflect on these areas as well as issues directly related to this project.

11.1. Make improvements known

To gain the full benefits of environmental improvements it is important to mediate these changes to those who can affect the company's profit and progress. The group with the highest influence is the customers; they directly influence the company's profit by buying their products. It is also important to notify the employees the progress; they are the ones directly working with the improvements and are a good source of ideas of improvements.

11.2. Systemize environmentally thinking

The idea of environmental thinking should not be left for just one group of people in the company. There should be one group that collects and distributes data and runs special projects but it is needed by anyone to deal with environmental issues in the daily work.

11.3. Visualize improvements

To remain on high levels of recycling and keep the motivation up for those who working with it, it is important to visualize the results. With feedback on the results it is possible to make changes if something is not working.

11.4. Recycling ladder

On the recycling ladder the second best options is to reuse the material and the third best option is to harvest the energy in the material. The best option, economical and for the environment, is to not produce any waste. If it is possible to calibrate the machines and plan the production in such a way that everything was perfect you would not get any waste needed to taken care of.

11.5. Emphasize the personal responsibility

When the environmental work is judged on a collective level it is easy for the employees to marginalize on the personal responsibility. Any specific effort from one person would not be as visible among a large group of people doing the minimum required as wanted.

11.6. Continue the work

This project has focused on the largest fractions of waste, mainly the ones from the production and its support functions. To make sure everyone feels involved and to show that the ambition is to reduce the environmentally bad emissions it is important to involve all functions of the company. Next in line of improvement would be the sanitation and kitchen. After that the work should include areas such as sales division and office spaces.

11.7. Reflections

Due to the many interest involved in this project, from users to those making the decisions for investments it has been very hard to predict real scenarios of the implemented solutions. Thanks to the quick implementations and test runs it has been possible to solve problems at an early stage that otherwise would not have been detected until the solution had been taken operational.

12. References

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3. Jolanta F. (2011) Analys av snus. Report, SP Technical Research Institute of Sweden

Appendices

A. Enquiry, Environmentally friendly waste handling

B. Enquiry, Shredder

Appendix A

Förfrågan

Miljövänlig spillhantering SMNE

(1 bilaga – Analys av snus)

Underlag

- Besök i Kungälvsfabriken
- Mottagande av exempel på spill
- Samtal på telefon.

Bakgrund

Ny teknik och ökade råvarupriser har lett till ökade möjligheter för material- och energiåtervinning av kasserade produkter. Detta i samband med ett ökat intresse av miljövänlig hantering och produktion inom SMNE har lett till en inventering av nuvarande hantering av produkter som inte når upp till SM's kvalitetskrav där det framkommit att både ekonomiska mål och miljömål kan uppnås genom ökad sortering.
I Swedish Match koncernpolicy för miljö står att läsa:

*"Swedish Match kommer att övervaka produktionen av avfall och **de metoder för slutligt omhändertagande som används**, i strävan att minska mängden avfall per producerad enhet"*

Ett miljömål på sikt för SM är att inget spill ska sorteras som brännbart, alla fraktioner ska istället sorteras och material eller energiåtervinnas under bästa tänkbara förutsättningar.

Volymer

Göteborg

Volymer för Swedish Match fabrik i Göteborg, beräknade utifrån tidigare års siffror.

Tabell 1, Kvantiteter Göteborg

Benämning	***Kvantitet [ton]***	
Brännbart		
Snusmjöl	X	
Bakpapper	X	
Övrigt	X	
Toft:		X
Wellpapp		X
Kartong		X
Kontorspapper		X
Sekretess, papper		X
Mjukplast		X
Metallskrot		X
Trä, blandat		X
Grovt avfall		X

Kungälv

Volymer för Swedish Match fabrik i Kungälv, beräknade utifrån tidigare års siffror.

Tabell 2, Kvantiteter Kungälv

Benämning	*Kvantitet [ton]*	
Brännbart		
Prillor	*X*	
Plast	*X*	
Bakpapper	*X*	
Snusmjöl	*X*	
Mald blandat	*X*	
Övrigt	*X*	
Tot.		*X*
Wellpapp		*X*
Kontorspapper		*X*
Sekretess, Papper		*X*
Mjukplast		*X*
Metallskrot		*X*
Trä, blandat		*X*
Grovt avfall		*X*
Plast PP		*X*
Plastband		*X*

Fraktioner

Fraktionerna prillor, plast, bakpapper och övrigt under brännbart är i dagsläget blandade. Vid lönsam energi- eller materialåtervinning finns möjligheten att separera dessa vilket dock kräver en viss investering.

Prillor

Prillorna går idag blandat med brännbart men möjligheten finns att sortera ut en större andel av dessa och lägga dem i en separat container. Prillorna är snusmjöl förpackat i en liten fiberbaserad påse med en liten del plastbaserat bindemedel. Påsen utgör ca 4 % av prillans massa, resterande 96 % är snusmjöl.

Snusmjöl

Snusmjölet förpackas i wellpappkartonger med en inre plastpåse med en volym på ca 0,6m^3. Denna förpackning är svår att ändra på.

Plast

Plasten som både finns sorterad och som del i den brännbara fraktionen är dosor och lock av polypropenplast. Dosorna kommer i blandade färger från vita till svart. Locken har i de flesta fall en etikett på sig av papper.

- Dosa stor, underdel: 6g
- Dosa stor, lock version 1: 6g
- Dosa stor, lock version 2: 3,5g

- Dosa liten, underdel: 3,4g
- Dosa liten, lock: 4,3g

Wellpapp
I Göteborg och i Kungälv sorteras wellpapp från förpackningar vid flera stationer i fabriken och läggs i komprimatorer i dagsläget. I Göteborg samlas även kartongerna som tobaken levererats i ihop, dessa viks ihop idag och lagras till dess att en större mängd uppnåtts då de skickas till återvinning. Dessa större kartonger motsvarar ca Xton/år

Kartong
Kartong från tillverkningen av pappdosor för lössnus i Göteborg huggs till en mindre fraktion och läggs i komprimator, även mindre ohuggna kvantiteter hamnar där. Denna kartong har ej varit i kontakt med snus. I dagsläget blandas den med en mindre fraktion wellpapp på grund av containerbrist.

Bakpapper
Detta silikonbelagda papper är resterna från etiketteringen. I Göteborg sugs detta genom en kvarn innan det transporteras till komprimatorn för brännbart. I Kungälv rullas papperet upp på rullar med en diameter på ca 20cm, rullarna slängs sedan i brännbart idag.

Mald blandat
Paketerat snus och lösa dosor som av någon anledning inte ska säljas kommer att köras genom en kvarn för att förhindra att dessa produkter når marknaden. Denna fraktion består av prillor, dosor, wellpapp och en liten del krympplast nermald till 10-25mm bitar.

Övrigt
Denna fraktion består av mindre kvantiteter blandat spill som inte blivit sorterat. Även lokalvården samt kökspersonalens avfall hamnar under denna kategori.

Grovt avfall
Består av en mindre del avfall från verkstad och fastighetsavdelningen, t.ex. gips och isolering.

Plastband
Plastbanden komprimeras idag i en balpress och hanteras på pall.

Mjukplast
Mjukplasten komprimeras idag i en balpress och hanteras på pall

Papper
Både kontorspapper och sekretesspapper hanteras idag i inhyrda kärl strategiskt placerade i fabriken.

Metallavfall
Metallavfallet är avfall från verkstaden där metallbearbetning sker i främst rostfritt stål.

Blandat trä
Denna fraktion består av blandat material från fastighet samt trasiga och udda pallar från spedition

Prestanda

Tidsplan
Kärl och behållare avtalade att tömmas av leverantören skall tömmas innan full fyllnadsgrad uppnåtts. Tömning bör ej heller ske före 85 % fyllnadsgrad för minimerad miljöpåverkan.

Kapacitet
Levererad tjänst skall hantera de förväntade volymerna inklusive temporär volymökning inom rimliga gränser utan att fördröja SM's produktion eller skapa merjobb för SM.

Acceptans
Tjänsten och ev. produkter accepteras när avtalad kapacitet är uppnådd, SM äger rätten att häva avtalet utan kostnad om acceptans ej uppnås inom 2 månader från införande.

Förväntningar/åtaganden
Vårt mål är att nå en kostnadseffektiv och miljövänlig hantering av de kasserade volymerna. Vi förväntar oss en ärlig och fungerande hämtning och tömning av kärl och containrar baserat på fyllnadsgrad för minimering av onödiga utsläpp under transporter. Vi uppskattar även full insyn i vart dessa volymer fraktas för att kunna beräkna våra totala utsläpp. Utöver detta vill vi ha full dokumentation av kvantiteterna av de olika sorteringarna samt kostnaderna/priserna för deponeringen på månadsbasis.

Vid hyra av containers, komprimatorer, kärl och dylikt önskar vi en inventering av vårt nuvarande bestånd samt förslag på nya förbättrade lösningar.

Kontinuerligt arbete
Fabriken är godkänd enligt ISO14001 vilket innebär att vi för ett kontinuerligt arbete för att minska vår miljöpåverkan och miljöbelastning. Vi ser att ni är involverade i detta arbete genom ständiga förbättra processer och introducera ny teknik. Ser ni områden där SM kan förbättra sig vill vi se att ni påpekar detta för oss.

Kostnadsuppdelning
I offerten vill vi se kostnaderna eller intäkterna för vart och en av volymerna vi har angett ovan. Beroende på vilka lösningar som påtänks för kvaliteterna prillor, snusmjöl och bakpapper ska dessa beräknas som brännbart alternativt det nya användningsområdet.
Vi ser gärna en offert på polypropylen plasten både i det fallet den levereras obehandlad i transparanta 190 liters säckar samt om den levereras mald i exempelvis ”bigbag”.

Transportkostnaderna bör offerteras separat liksom hyran av kärl, containrar, komprimatorer och dyl.

De individuella priserna ska baseras på att alla tjänster och volymer upphandlas genom en leverantör.

Leveransomfattning

Vi önskar en tydlig specifikation från er sida på vilka krav som ställs på materialen vid mottagandet för att nå överenskommet pris. Denna specifikation ska även innehålla de krav och klassifikationer ni gör på material ni köper beroende på renhet, storlek, förpackning etc. Om önskade krav på fraktioner inte uppnås kräver SM att detta meddelas snarast, absolut innan efterföljande tömning.

SM önskar en riskanalys av tjänsten där tänkbara scenarion tas i beaktande.

Poster som inte inkluderas i leverantörens åtagande

Följande utrustning och service kommer tillhandahållas av SM vid vardera fabriken:

- elförsörjning 3x400 VAC, N+ PE (TN-S)
- elförsörjning 230 VAC
- Lastkaj
- Utrymme för lastning och lossning av containrar
- En (1) tvåfacks balpress
- Daglig tömning av behållare och kärl inom produktionen.
- Motviktstruck, 1,6ton lyftkapacitet
- Uppställningsplats för pallar, inomhus

Service och underhåll

Leverantören garanterar funktionen på levererade lösningar. Löpande service och underhåll av lösningar som t.ex. komprimator sker av leverantören.

Säkerhet

Gällande lagar och regler skall följas.

Installationsförutsättningar

- Containrar/komprimatorer och dylikt placeras utomhus på plan asfalterad yta
- Skydd mot att containrar och dylikt sjunker ned i asfalten ombesörjs av leverantör
- Ev. nödvändig elförsörjning ordnas av SM

Offertens utformning

Offerten skall innehålla utöver ovan nämnda punkter:

- Leveranstid
- Dokumentation
- Betalningsvillkor
- Garantivillkor
- Intyg att SM’s krav uppfylls

Utbildning

Nödvändig utbildning sker på plats i respektive fabrik

Övrigt

Frågor rörande denna offert besvaras av:

[redacted]

Tekniska frågor besvaras av:

[redacted]

[redacted]

[redacted]

Appendix B

Inquiry shredder

7 June 2011

Swedish Match NE AB

Our reference: [redacted]

Your reference: [redacted]

In case of conflict the Swedish version of this inquiry is correct

SWEDISH MATCH

Contact:

Commercially responsible
[redacted]

Technical questions:
[redacted]

[redacted]

[redacted]

1 Background
Swedish Match wants to make sure that no products left for deposing has a value when leaving the factory. If these products would be grinded down to smaller pieces when placed in the waste container, they are considered to be of no value. A shredder can prevent batches of faulty and new products to reach the black market. The shredder would secure a safe waste handling for Swedish Match

2 Foundation
- Conversation over phone
- Visit at the Kungälv factory, tour and description of current situation.
- Walkthrough of material to be shredded, volumes and handling.

3 Function
The shredder is to be used for grinding down boxes with packed snus cans, both portioned and loose, also garbage bags with mixed waste from the production should be handled. The shredded material should then automatically end up in the dedicated container. The shredder should be able to handle wood containing small amounts of nails.

4 Technical demands and capacity
Below are the basic requirements for the shredder.

4.1 Material to be shredded
The shredder should be able to handle both boxes with snus and garbage bags.

4.1.1 Boxes with snus
Packed boxes with snus ready for shipment, containing 240 cans with loose or portioned snus. Dimensions up to 450x250x300mm. Weight per box: 8-15kg

4.1.2 Garbage bags
The bags have a volume of approximately 150l and contain mixed waste from the production such as: pouches, cans, backing paper with an approximately weight of 25kg/each

4.2 Capacities/dimensions
Minimum 1ton/hour. The shredder shall shred 2-3 tones material a day

4.2.1 Hopper
The hopper should have a volume of at least 1,8m^3 with a width of at least 1,5m. 30 boxes with an estimated volume of 1,5m^3 should be possible to put in the shredder at once. 15 bags at once from a forklift operated folding dumpster, should be possible to put in the shredder. The folding dumpster has a width of 1,3m and a volume of 1,8m3. The hopper should be designed so that the forklift driver easily can move the boxes from the pallet to the shredder.

The bags are collected in a folding dumpster located centrally in the factory. Once it is full it is driven by a forklift and emptied in the shredder. In the front of the folding dumpster there is a pressure plate located that when pushed makes the dumpster tip over and the bags to fall out. There is therefore a need of something in front of the hopper or at the hopper itself to withstand the force of being hit by the dumpster's pressure plate. A solution of this should be presented.

4.2.2 Height of hopper/shredder

The shredder should be located in front of a loading platform with a height of 1250mm. A safety requirement is that the intake of the hopper must be at least 1100mm above the loading platform. In summary the shredder including hopper must have a minimum height of 2350mm on the side of the platform, the maximum height is 2550mm.

4.2.3 Pusher

To make sure that the materials under no circumstances jam in the hopper, we believe that a pusher is necessary. That is an automatic arm pushing the material towards the rotor. If the supplier believes that no such device is necessary he should guarantee that the materials to be shredded don't jam in the hopper.

4.2.4 Other dimensions

As the shredder is to be placed in front of a loading platform it is important that the shredder is as narrow as possible, the maximum width is 3m including the transportation system from the shredder to the container. The depth, perpendicular to the loading platform, is not as crucial.

4.3 Size of the shredded material

No fractions larger than 25mm should pass through the shredder.

4.4 transportation system

The shredded material should end up in a garbage compressor placed next to the shredder. The compressor is 2400mm high and approximately 2m wide. The transportation system should take up minimum space alongside the loading platform. The outlet of the transportation should be in the center of the compressor and no material should leak from the transportation system or the shredder. The transportation system should be dimensioned for the volumes the shredder handles with room to spare.

4.4.1 Further desires

It is desired that the shredder also can handle PP-plastic in the shapes of cans and lids. These cans and lids are pure plastic fragments deemed for material recycling. To increase the density the material should first be shredded. This material should then preferably be packed in "bigbags". What possible solutions are there for this problem? Is it possible to use one transportation system that can be moved between the compressor and the bag? Should we use two transportation systems? Does the shredder need to be cleaned between the two different materials since the plastic needs to be kept relatively clean and if so, how is it done? Is it possible to construct the transportation system to reach even further containers?

4.5 Power connection

The shredder should be connected using a CE- standard plug

4.5.1 Control

- The transportation system should be activated when the shredder is activated
- The control unit should be located on the loading platform and be easily accessible and easily operation by the operator

5 Location and environment

The shredder should be placed outdoors unprotected for the weather. The control unit should be placed outdoor but under a canopy.

6 Local situation

The supplier should be familiar with the situation at site and collect the information he believes is necessary to predict the installation work.

Before any work begins the installation site should be inspected, buyer and supplier together.

Special permission is necessary for welding, cutting and working high speed grinders.

Any eventual packaging material should be sorted following SM standards

7 Service and maintenance

The supplier should provide a proposal to a spare parts list including prices and delivery times. The supplier should guarantee access to spare parts for 10 years. Rules regarding spare parts under guarantee time should be specified.

Further requests

- Time to service that can be guaranteed in case of breakage
- An estimation of costs (LCC) regarding service and spare parts for a period of 10 years (based on estimated volumes of today).

8 Education

Once the equipment is installed and approved the affected personnel should be educated about operation and service.

9 Other requirements

- Cables should be installed using cable ladders to avoid rats as much as possible.
- Energy consumption should be specified in kWh/working hours

10 Common requirements

- The equipment should be constructed, manufactured and installed in accordance to international and European standards.
- EG-directives should be followed.
- The entire delivery should be CE marked and be followed by a guarantee of conformation.
- All equipment should be professionally constructed.

11 Noise
The machines sound levels during normal operation should be specified.

12 Comprehension
The delivery should include:

A fully operational and ready to run equipment according to this enquiry.

The shipment should include construction, manufacturing, installation, connection, documentation, start up and testing of the equipment.

The delivery should also contain following:

- Transportation to factory including packaging, loading, and unloading
- Risk assessment of potential dangers
- Education of operators and service technicians
- Estimated costs for spare parts according to suppliers suggested spare parts list
- Guaranteed accessibility
- All mechanical all electrical documentation
- Suggestion of time schedule for supplier activities

Posts not included in the supplier's commitment:

Following equipment is supplied by SM:

- Building
- Sheet metal foundation for the shredder
- Electrical preparations according to requirement including outlet

13 Acceptances
For the equipment to be approved the requirements in this inquiry should be fulfilled. If these are not fulfilled measurements should be taken to correct this, maximum time for this measurements is 2 months. Once the supplier is done a new test of acceptance is performed.

13.1 Clarification of acceptance
The supplier must guarantee that the shredder and transportation system fulfills the requirements. Earlier studies have shown that some shredders have made a mess when loose snus is shredded. The snus did the jam the machine and the material had difficulties to pass. This may not happen under any circumstances neither in the shredder nor in the transportation system.

The hopper must be big enough so that bags or boxes can't jam.

Testing at delivery is performed by shredding larger quantities, to make sure the requirements are fulfilled.

If these requirements are not fulfilled does Swedish Match have the right to abort the deal after delivery, all costs are taken by the supplier.

The supplier is responsible for that the entire equipment is insured until acceptance is approved by SM.

14 Quote layout

- Each post should be specified, such as shredder, hopper, transporter, transportation, installation and so on. One price for the entire delivery is not acceptable.
- To be able to calculate the profitability we wish a calculation of costs for service and spare parts over 10 years. Calculations should be made based on specified volumes.
- Complete blueprints of the installation
- Certification that guarantee all requirements in this inquiry is fulfilled

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- Copy of manual according to 1.7.4.2
- EG insurance according to appendix 2A
- What documentation is supplied, according to appendix 7A

Payment

- Payment terms
- The offers period of validity

Remaining

- Delivery time
- Guarantee conditions
- What documentation is attached
- Suggested list of spare parts

Swedish Match is looking for long time relationship with its supplier where mutual trust is the foundation of good business.

We welcome your solutions and offers!

Best regards

Swedish Match