ArcelorMittal Design Project

Engineering Design and Graphics 100

Section 20

Team 8

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Abstract

Industrial waste is one of the biggest contaminants nowadays. Companies used to spend money on storage and treatment of the waste, which caused high amounts of contamination and losses for the company. Nowadays there are many options of recycling waste that are ecological and affordable for a company. Waste is now being considered as a way of getting materials for production by reusing it.

Arcelor Mittal is the biggest producer of steel in the United States, therefore they produce high amounts of waste during the year. Right now they are trying to find the best way to recycle their waste that lower's their ecological footprint and also saves them money and time. Our goal is to present a recycling project for one of their waste types and present it to them. The product we are trying to recycle is the drums and totes used to transport materials to Arcelor Mittal. What we are trying to do is to find a way to recycle these materials that is affordable for the company and that in some way gives some material for production to Arcelor Mittal. For us this is an excellent way to recycle these materials as it gives Arcelor Mittal the opportunity to recover some of the costs of recycling, while they help to protect the environment.

Introduction

Landfills in America are filling up fast from the mass amount of items thrown in the trash each year. Many of these items did not need to be thrown away but rather recycled or reused. Everyone can take preventative measures to reduce the amount of trash collecting in landfills. ArcelorMittal is a company that is trying to make the next step and reduce their waste going to the landfill. They asked engineering students at Penn State to come up with a way to recycle or reuse products from their location such as wooden pallets, waste refractory brick, metal drums, and plastic totes. We have focused our project on reusing the metal drums and plastic totes. Our project had to deal with safely disposing of the drums and totes since they both contain remains of hazardous substances inside them.

Mission Statement

Our mission is to recycle or reuse the excess steel drums and plastic totes ArcelorMittal has at their Harrisburg, Pennsylvania plant. We want to accomplish this using an engineering design method, but we also want to keep in mind the availability of outside companies who specialize in cleaning or depositing of these objects. We want to accomplish this safely so the hazardous remains inside do not damage the environment. We also need to consider ArcelorMittal's money and time. This requires us not to suggest an idea that costs a lot of money or requires ArcelorMittal to do more work than they already do.

Customer Needs Analysis

The customer, ArcelorMittal wants to create a process that is "cradle-to-cradle"- meaning they want to reuse everything they possibly can and find a way to use it instead of throwing it out. They want a way to reuse or recycle their left over items so they do not go into landfills. They

want to accomplish this through the values their company has; sustainability, quality, and leadership. Water treatment chemicals are present in both the totes and drums (chemicals to prevent algae growth come in the 50-gallon plastic totes while antifreeze comes in the 50-gallon drums) so they need to be cleaned properly beforehand. While doing this project they want us to consider the impact our proposal will have on the environment and the community. We also need to make sure shareholders in the company will agree with our proposal and share the vision we have. Finally, we have to assure our proposal meets all these requirements, respects codes that are involved with it, and is economically possible.

House of Quality

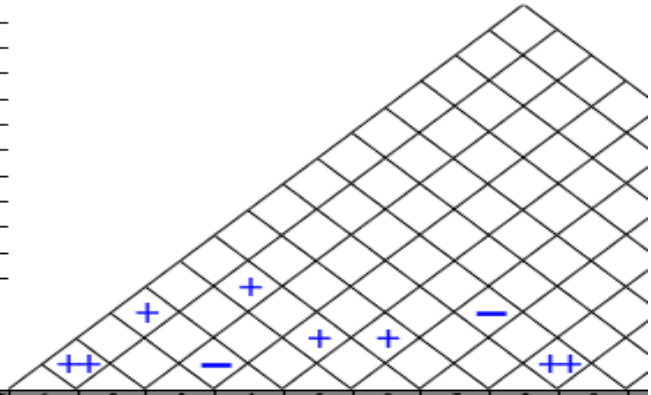
This is the house of quality we used for our project. We used some of the customer needs that were stated in the customer needs analysis above, and what we planned to do with those needs. We did not have any companies competing with us since this project is just for Penn State engineering freshman. The circle with a line through it represents a strong relationship, circle is a moderate relationship, and triangle is a weak relationship. The double plus signs are positive correlation, the plus sign is a positive correlation, and the minus sign is a negative correlation.

Title: _____

Author: _____

Date: _____

Notes: _____



Row #	Max Relationship Value in Row	Relative Weight	Weight / Importance	Demanded Quality (a.k.a. "Customer Requirements" or "Whats") / Quality Characteristics (a.k.a. "Functional Requirements" or "Hows")	1 Find a company or method to reuse drums	2 Find a company or method to reuse totes	3 Melt down steel to make more product	4 Hire someone to clean them	5 Send them out to a company to be cleaned	6 Make sure they don't end up in a landfill	7 Meets FDAA standards	8 Give them to the community	9 Give them away free to the public
				Direction of Improvement: Minimize (▼), Maximize (▲), or Target (X)	X	X	X	▼	▼	▲	▲	▲	▲
1	9			Reuse or Recycle drums	⊖		O	O	⊖			O	▲
2	9			Reuse or Recycle plastic totes		⊖		O				O	O
3	9			"Cradle to cradle" process			⊖						
4	9			Handle hazardous materials				O			⊖		
5	9			Reduce waste footprint	⊖							⊖	⊖
6	9			Make sure the process meets all codes						O	⊖		▲
7													
8													
9													
10													
				Target or Limit Value									
				Difficulty (0=Easy to Accomplish, 10=Extremely Difficult)	4	7	3	2	5	1	3	1	1
				Max Relationship Value in Column	9	9	9	3	9	3	9	9	9
				Weight / Importance									
				Relative Weight									

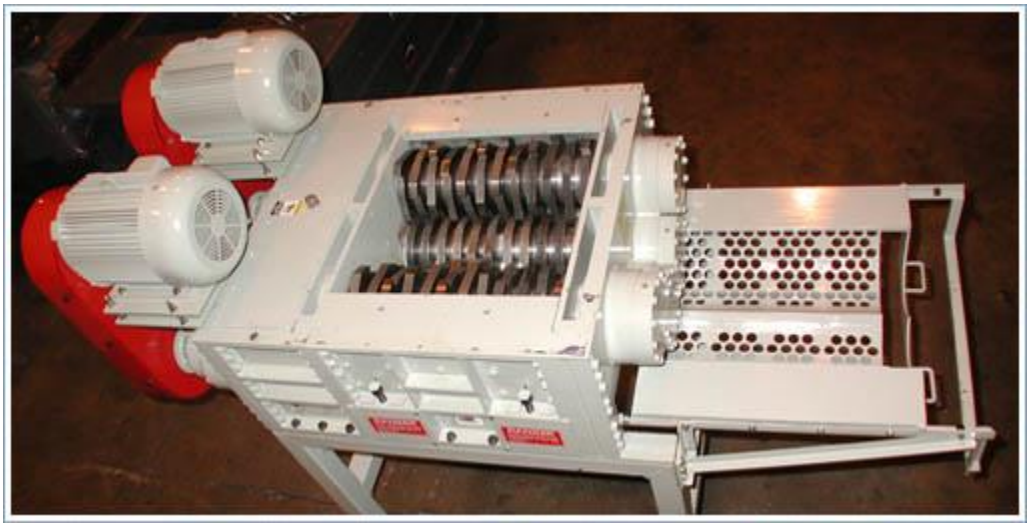
External Research

Our main goal is to create a process were we could shred the material of the drums and use it as product for the company. This process could include other companies that could help us with the shredding and transportation process.

As drums are used to transport oils and lubricants, they need to pass a cleaning process. For this we intend to use pressurized guns that remove the waste from the drums, then cleans it

and absorbs the cleaning product used. Then the drums should be transported to a place where they can be shredded. Companies like Incineration Services, do the process for shredding the drums, but their condition is that the drums passed through a cleaning process. They also are responsible for the transportation of the drums[1].

The shredding process is extremely important as it gives the company some product that could be molded and used for other purposes. Industrial shredders from the company Komar are extremely effective as their shredders have multi-edge cutting shredders that can shred 50 gallon drums easily. The drums would be transported monthly to the place where they will be shred. The transportation on the way there is going to be much more expensive than the way back as shredding the product saves a lot of space in the transportation process[2].



The scrap metal that was left from the shredding process, will be transported back to Arcelor Mittal, where it has to be processed in a way it can be used by the company. Scrap metal first has to be separated into ferrous and non-ferrous metal. This process consists on using radiation separators and magnets that separate the scrap metal. Then when the ferrous metal is found, personnel from Arcelor Mittal would have to separate manually which metals are recyclable and non-recyclable. This is a process that could be perfectly done by Arcelor Mittal as they specialize on the steel industry. Recyclable materials will be taken to steel mills where they will be turned into steel. Non-ferrous metals will be used for other purposes as they have different recycling processes. Non-metals will be used as landfill[3].

The steel making process consists of three different steps: melting, removal of impurities, and shaping of the metal. First the scrap metal is taken to a coke oven that works with coal. Many ovens would have to work simultaneously so that you could transfer the heat and save energy. Heated air then causes the iron production by causing the coke combustion. The product from this process is then transported to an oxide furnace. High purity oxygen will be blown into the furnace, so that we turn the melted iron into solid iron. Alloy materials will be added, so that we enhance the characteristics of the steel[4].

For the tote recycling, we will have to clean them in the same process we used for the metal drums. The totes will then be transported to encore recycling services that could buy us the totes, to consequently recycle them and sell them[5]. For the recycling process this company follows a number of steps:

- Call Encore Container and place an order for drums or totes (or submit an online order). New or reconditioned drums/totes are delivered to supplier with short lead times.
- Supplier fills containers and ships to end user.
- End user empties container and calls (877) 380-1188 for free pickup within 48 hours (or request pick up online).
- Containers are brought back to Encore Container, cleaned, and stored in-house at a green-field facility (inside and under cover).

Reduce the risk of your drums ending up in an EPA super fund site and avoid costly clean-up fines.

Concept Generation

Our mission is to reduce ArcelorMittal's waste stream at one of its facilities by designing an opportunity to reuse and or recycle one or more of the largest sources of refuse: pallets from incoming material delivery, empty drums or totes received from delivery of fluids, and waste refractory brick. The instructor of the class gave each team a homework assignment one week. The assignment was that each team member was to create their own concept and bring it into class. From there, the team collaborated as a group to create even more ideas, or even branch out on the 9 ideas brought in by other team members. By the end of the assignment, the team had come up with eight total ideas including: sending them directly to the company, shredding of the drums and totes, doing the cleaning process.

Concept	Description
A	Recycling company in the U.S and Canada specialized in totes recycling. Picking up a certain amount of totes in a time lapse of 48hrs. They charge for their services.
B	If primary shredding is main requirement, look to low-speed, high-torque 2-shaft electro-mechanical or hydro-mechanical shear shredders. The high quality metal shredding models handle steel drums, door and window frames, scrap / trim, metal skeletons and many other production items that require a primary shred or strips. Primary shredding of large, bulky items can save thousands of dollars on annual transportation costs.

C	Rinsed out so the chemicals are gone from it. They can be donated to the local community or given to the employees.

Concept Selection

The team knew that from the initial research that was done on the reuse or recycle drums and totes process that what was wanted an idea that could effective and saving money. The initial research helped us to how to recycle drums. This helped us to give a jump start on what kind of ideas the team should be thinking of.

The concept screening matrix used by the team found that three concepts would be further developed. The one would be dropped. The reason the two passed was because they ranked very high according to the consumer needs shown in the AHP chart. The three concepts that were to be continued according to the screening matrix are concepts A and C.

	A	B	C	REFERENCE
Cost	0	-	+	0
Effectiveness	+	0	-	0
Time	+	-	+	0
Accuracy	+	+	0	0
Running cost	+	-	+	0
Ease of separation	0	-	-	
Environmental impacts	+	-	+	
Pluses	5	1	4	
Minuses	0	5	2	
Zeros	2	1	1	
Net	5	-4	2	
Rank	1	7	3	
Continue	yes	no	yes	

The reason why concepts A and C were continued was due to the high scores the received. They all had mainly grades of pluses or zeros on the selection criteria. Because of that, the team thought that these concepts had the best chances of being able to solve the problem presented by ArcelorMittal. These concepts were then fully developed to see which ideas would perform best to solve the problem.

Design Description

According to the plan, we need to reduce ArcelorMittal's waste stream from empty steel drums and plastic totes received from delivery of fluids by designing an opportunity to reuse or recycle them. And we also need to consider about the expense on that so the plan will be enforceable.

Since all the materials in the totes and drums are water cleaning chemicals and antifreeze, we will use water to wash them first to remove most of the waste inside. Then use process of neutralization to clean remain. After that, for the drums we will shred them into scrap metal and manufacture scrap metal into steel. Because ArcelorMittal has one of the biggest plants to manufacture steel from scrap metal, the shredding process and the manufacture should be ideal for them. However, there're some part of the drums can't be recycled like cap, so we will send them to incineration company. We are also partnering with incineration recycling services in New Jersey. As for the totes, after wash process we can donate part of them to the local communities or give them to employees. The totes can be used as the storage containers, outdoor planters, rain barrels, compost system or roofing for a greenhouse. Then other part of those totes will be sent to recycling companies. There's a company called Encore Container which will pick up for free and pay for the totes, so we can cooperate with them.

Conclusion

In conclusion, the final product ended up a success as it fit the needs of ArcelorMittal. Our design plan for ArcelorMittal is not only enforceable in that it satisfy the needs to recycle them, but it also make some profit from these totes and drums. All of our process considered about the effect to the environment and give the ArcelorMittal most profit return. We focus a lot on the profit because after all ArcelorMittal is a company, if we can at the same time recycle the wastes and make profit from them, it should be ideal for ArcelorMittal. All in all, the plan will be an example of recycle drums and totes for companies and might applied in the future usage.

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