ArcelorMittal Project

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Team Picture:
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CAD Model of the Typical Drum ArcelorMittal Uses

The average 55 gallon drum is 35 inches high, with a 24 inch diameter. The hole, or bung hole, is normally 2 inches in diameter.
Executive Summary

The world’s largest producer of steel, ArcelorMittal, has encountered a problem with their sustainability cycle regarding their steel and plastic drums. The need for such a large supply of different chemicals and liquids to facilitate the steel production process has left the company with a surplus of empty steel and plastic drums. As a result, the company has been left with the problem of being able to both successfully reuse these drums, and to have a recycling plan in the future for the drums that are unable to be reused. The objective of the project is to find a clean and efficient way to reuse or recycle the steel and plastic drums left over.

The process of cleaning was thoroughly researched beforehand, with existing options being evaluated as the best solution. These existing options included what the company was already doing to clean their surplus drums, sodium hydroxide, sodium nitrate, and ethyl glycol. Benchmarking research was conducted in order to gauge what was being done generally with other companies. It was found that the steel process in general creates large amount of waste, but fortunately the vast majority of which can be successfully recycled and reused with proper processes. These processes included recycling the steel and plastic and developing our own drums to eliminate the need for a surplus, and also sending away our drums that are able to be reused to another company in order to eliminate the need for the company to spend money on the cleaning process. We took these processes and scored them each with a design matrix based on a conjunction of ideas from both us and the customer’s needs. Based on the results from the matrix, we decided to improve the already existing process of cleaning the drums rather than sending them away to another company to both save money from paying the company and also transportation. The problem of recycling the drums will be solved by recycling the steel drums for the customer’s own use since it is already a steel producing factory, and the plastic drums will have to be sent to another company to be recycled in return for a small fee.
As with any preliminary process, there are many risks involved. Most importantly, the more efficient cleaning process could end up being more harmful for the environment. The chemicals must be properly taken care of, and waste management may end up costing more than what is saved from the more efficient process. This risk will be combated with a carefully selected process in which the chemicals will be able to be properly taken care of along with the waste that is already being disposed of in the ArcelorMittal facility. This will allow the process to just be taken care of with the waste management process already in place. Some minor risks include the mixture of unwanted metals in the recycling of the steel. Steps to avoid this will be taken by having a conveyor belt that specifically targets the steel using magnets thoroughly picking through the metals. The final process, with all variables taken care of, is to be presented on May 4th, 2015.
Introduction

The objective of our assignment was to reduce the waste stream at an ArcelorMittal facility by designing a way to reuse or recycle one or more of the largest sources of refuse. ArcelorMittal is the world’s largest steel and mining company. The steel they produce has a large impact on the sustainability of our future. However, this does not come without some challenges. The cycle of steel as it is now produces a large amount of carbon emissions. These emissions contribute to the growing problem that is global warming. Steel has the potential to be the world’s most sustainable material. It is strong, flexible, and can be recycled endlessly. For this happen, it is imperative that steel uses less energy and emits less carbon.

This is where our project comes into play. It is our job to ensure that steel reaches it’s full potential as a sustainable material. The area of the steel cycle that we focused on was the reuse and recycling of steel drums. We planned to improve the way in which they were recycled and how to make their cleaning process less hazardous.

Having a cleaner steel fabrication cycle and creating a more sustainable material, will ultimately help the world become a more conserving and economically conscience place. There are only ways to improve this cycle, and by designing a way to reuse or recycle large sources of waste.
List of Customer Needs

- A way to recycle, or reuse empty, and used drums, which can be made of both, steel, or plastic.
- The design needs to be applied to ArcelorMittal’s Long Carbon plant in Steelton, PA.
- The materials must be recycled from cradle-to-cradle.
- The plan needs to be cost effective, and viable for shareholders.
To work on this project, our group needed to use a wide variety of resources, including informational websites, ArcelorMittal’s websites, provided resources, as well as third party websites. We’ve also used resources from Penn State’s online library to find information relevant to our attempts to figure out a way to recycle steel, and plastic drums.

During the course of our research, we looked into the processes involved in the making of steel, as used by ArcelorMittal. It is from this, that we were able to select a particular part of the process to recycle, and we’ve chosen drums. After finding out more about how the drums are initially made, transported, and what they carry during the process of making steel, we then looked into how those materials contained in the drums can be cleaned off in the factory. Other than just washing, and reusing them, we also looked into other concepts, such as the idea of sending the drums off to third parties, who offer professional services that involve cleaning, and/or recycling the drums.

We believe that all our research has allowed us to come up with a feasible, well-informed plan of action, which will allow ArcelorMittal to sustainably use, and reuse steel, and plastic drums that it needs to manufacture steel.
Concept Generation, and Concept Selection

To come up with a concept for this project, we began with the general ideas. Steel drums, plastic totes, wooden pallets, and refractory bricks need to be recycled and reused in a sustainable manner. We looked into all of the options and chose the steel drums because it seemed like it could be the most beneficial to the company. After choosing to focus on steel drums, we then moved our focus to ideas of how we can make the process sustainable. We came up with a few ideas: sending the used up drums to a recycling plant to be recycled and eventually brought back into the steelmaking process, cleaning the drums on site and putting them back into the steelmaking process, and sending the drums to be cleaned off site and reusing them to store chemicals. Now that we had three ideas, we moved into the concept selection stage.

We rated each concept first, determining that the third concept was the best. But we still weren’t thrilled with the idea, so we decided to pick out the best parts of each concept. The first concept had the steel being recycled back into the steelmaking process, and we decided that should be the ultimate ending to a drum’s life. The next idea had the drums being cleaned on site before being recycled, and we liked the cleaning on site idea. The third concept had the drums being reused to store chemicals again. So combining the best parts of the three concepts we decided the most effective and sustainable process was to have the drums cleaned on site once they are empty, then refilled with chemicals until they reach a point at which they can no longer be reused. At this point they get chopped up and reintroduced into the steelmaking process, making it a completely sustainable cycle. Based on our selected concept, we came up with the cleaning process that will be used by ArcelorMittal to reuse the drums.
Design

When a steel barrel’s contents have been used up (i.e. there is less than 1 inch of liquid in it) it will be sent to a cleaning station. This station will first empty any left over liquid from the drum (this liquid is antifreeze and is biodegradable in the ground after 2-3 weeks), then it will be cleaned first with high pressure water. The water will force out most of the liquid residue. There will still be chemical residue in the container, so the drum will then have to go through sodium hydroxide cleaning process that will remove chemical residue. Sodium hydroxide will be reused because it can’t be released into the environment. After cleaning all chemical residue out of the drums, there is a sodium nitrate wash to remove rust if necessary. Sodium nitrate is also hazardous and can be recycled and used over again for the process. After this a second water wash is used to remove any sodium nitrate and sodium hydroxide. The water in these washes can be reused and cleaned of the other chemical through distillation. After cleaning, the drum then has to be dried because there can’t be any moisture if it’s to be used in steelmaking. The drums can be dried by using excess heat from the steelmaking process to evaporate out any residual moisture. At this point, the drums can be introduced into the steelmaking process and be melted down into new steel, some of which is made into drums that are again used to carry antifreeze for steel making. The drums, when empty, go through the whole process again.
There is no clear cut price for our solution, but the costs can be identified and proved economically feasible. The first cost is in on-site versus off-site cleaning. There will be costs to purchase the additional equipment needed to clean the drums on site. This equipment would be high-pressure hoses and nozzles as well as a conveyer system that moves the drums along the cleaning process. These costs would only be part of the initial setup of our system, and they would be paid for in the long run by reusing drums and keeping from outsourcing the cleaning. The next cost would be in the chemicals and water used to clean the drums. Our system works to reuse as much of the water and chemicals as possible while also using the heat from the steelmaking process to pressurize the liquids for a pressure washing. This means that the only cost here is in the actual purchasing of chemicals, and since the chemicals will be reused as much as possible, this would be a minor cost as well that is paid off by the saved money from reusing drums. These two costs would be far overshadowed by the money saved by refining and moving the drum cleaning process to within ArcelorMittal headquarters.
Conclusion

We believe that our proposed plan will ensure that ArcelorMittal will efficiently, and effectively be able to reuse plastic, and steel drums that are essential to the process that they need to produce steel. Our planned proposal is not just easy to use, but also extremely cost effective. This will allow, and encourage ArcelorMittal to use a sustainable, and environmentally friendly method to reuse their drums. As a result, the plan meets all our customer requirements, and hopefully satisfies them.
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