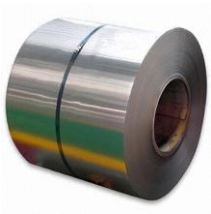
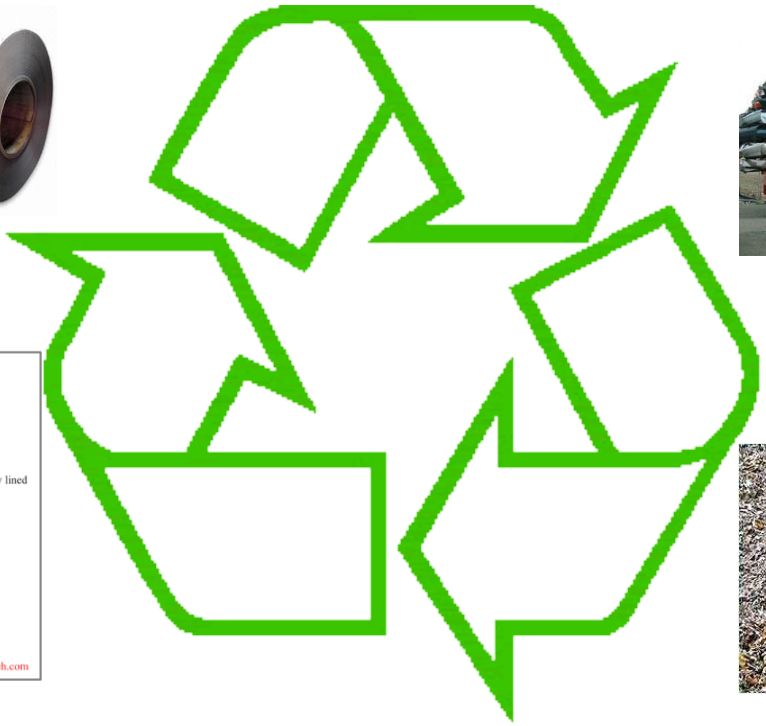
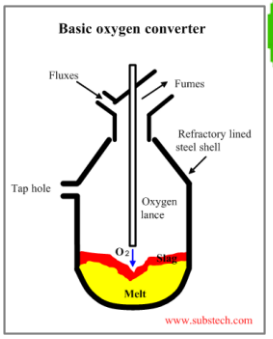
EDSGN 100 Design Project 2
Final Design Report

Recycling of Advanced High Strength Steel
Introduction to Engineering Design
EDGSN 100 Section 002

Team 2
Danielle Buckta: dqb5136@psu.edu
Kevin Knechtel: kck5097@psu.edu
Nancilee Rifenburgh: nor5064@psu.edu
James Van Sant: jdv5063@psu.edu







Executive Summary:

For our second EDSGN Project, we created a process to successfully separate different metals and find the AHSS. As a team, our objectives were to create a process that would correctly separate AHSS 99% of the time, prevent off chemistry heats when making steel, and perform the process 50% more efficiently than current processes. We came up with seven different designs including separation, stamping, coloring, microscopes, conductivity, magnetism, and density. After finding the pros and cons and looking over our different designs, as a team we concluded that our magnetism design was the most efficient, and fit all of the criteria (separate correctly, cost, efficiency, area needed, amount of change, and workers needed).

Submitted to: Professor Jin Date: 04/27/2012

Recycling of Advanced High Strength Steel (AHSS)

Table of Contents

1.0 Introduction
2.0 Project Background
3.0 Project Objectives
4.0 Conceptual Designs
    4.1 Descriptions
    4.2 Research and Analysis
    4.3 Concept review and Selection
5.0 Detailed Design
6.0 Conclusions
7.0 References

1.0 Introduction

The purpose of this design project is to refine the way Advanced High Strength Steel is recycled, specifically to refine how AHSS is removed from scrap cars. Cars are now made with more AHSS than in previous years; so when it is recycled with regular steel and is recycled the AHSS has a different composition which causes “off heat” in new batch of steel. We followed the Engineering Design process to come to a reasonable design. We first identified the problem with the current process, defined where, and what was flawed, and came up with possible solutions, and finally we chose our best design.

2.0 Project Background

The main issue with the recycling of AHSS is that there is no proper process of detecting it. With AHSS being used more in the automotive industry this will become an even larger problem if not handled now. When recycled in the current process the AHSS is mixed with regular ferrous material and dumped into a Basic Oxygen Furnace (BOF); this causes an imbalance in alloys present which makes the final product differ from the standard.

3.0 Project Objectives

In our project we are to develop a way to prevent off chemistry heats when recycling different types of steel, and if possible do it cost effectively. Mainly the cause of these off chemistry heats is the steel that is being recycled contains too much alloy. One of the main contributors of the extra alloy is the AHSS which is a high alloy steel. In order to prevent the AHSS from causing off chemistry heats our objective was to develop a way to separate the AHSS from the other scape steels.

4.0 Conceptual Designs

We came up with multiple solutions to this problem. Our first idea was to have people separate the AHSS before the car was put through the current process. The second possible idea was to stamp all AHSS steel in car,

done at the automotive plants. Third was coloring AHSS so it is easier to spot when destroyed, needs to be done during refining. Next was to use a microscope to differentiate between AHSS and regular steel. Another idea was a process that uses magnetism and conductive properties of different metals to separate them. Another was to use magnetism to attract all steel, and the strength would weaken over time to let the steel be separated. Our final idea was to separate the steel via density.

4.1 Descriptions

In our first process a worker, or team of workers, would be needed to tear the car apart and look for AHSS and then physically place it into separate bins. The second idea would be the manufacturer of cars would need to stamp AHSS parts in cars, GM has already started this; and then workers would be needed to physically separate the steel. The third idea would require the steel maker to add a dye or substance to change the color of the steel. Again workers would then have to physically separate the AHSS from regular steel. In the next idea microscopes would need to be installed in the recycling plant for workers to scan the metal as it passed. This idea however requires a lot of training on how to use and operate the machine as well as finding AHSS. Our next idea the metal is charged and then rides over a magnetic strip which repels the metal a certain distance according to its conductivity. The next idea was to use a magnetic conveyor belt which the strength would wane over a given distance, AHSS being less magnetic would separate first, and then they would drop on to different belts leading to marked bins. Our final idea dealt with the different densities of the metals. There would be a liquid with a density in between the densities of the two metals. This would separate the metal then simply scoop the metal off or out and put them in their respective piles.

4.2 Research & Analysis

We had limited resources available to us due to lack of materials, money, and time. However, we did use the internet and scholarly articles to research the background of the project and to find as much as we could in order to produce the most practical design. We got input from Arcelormittal on what their needs were and how to best solve the issue at hand. Using

our research and knowledge, we were able to analyze the situation and come up with ideas.

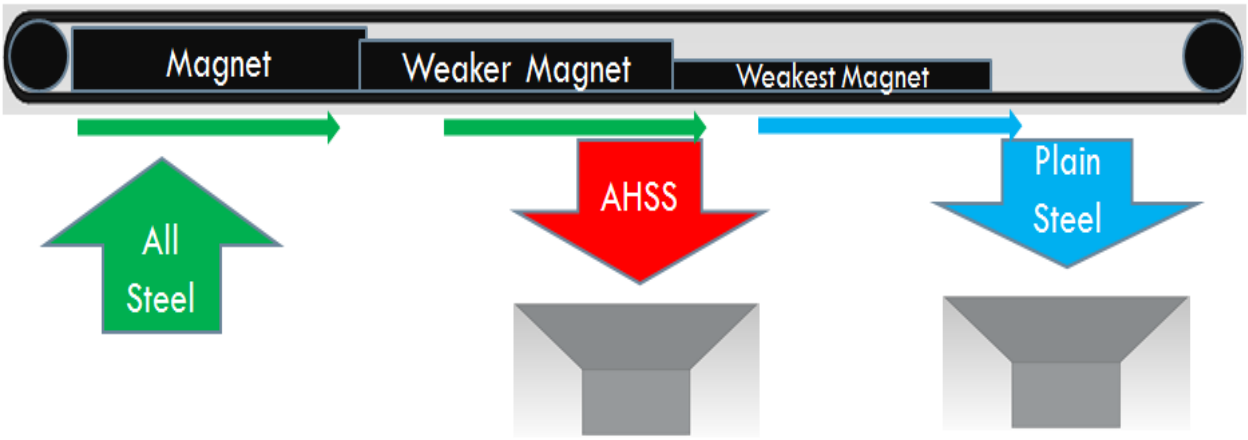
4.3 Concept Selection

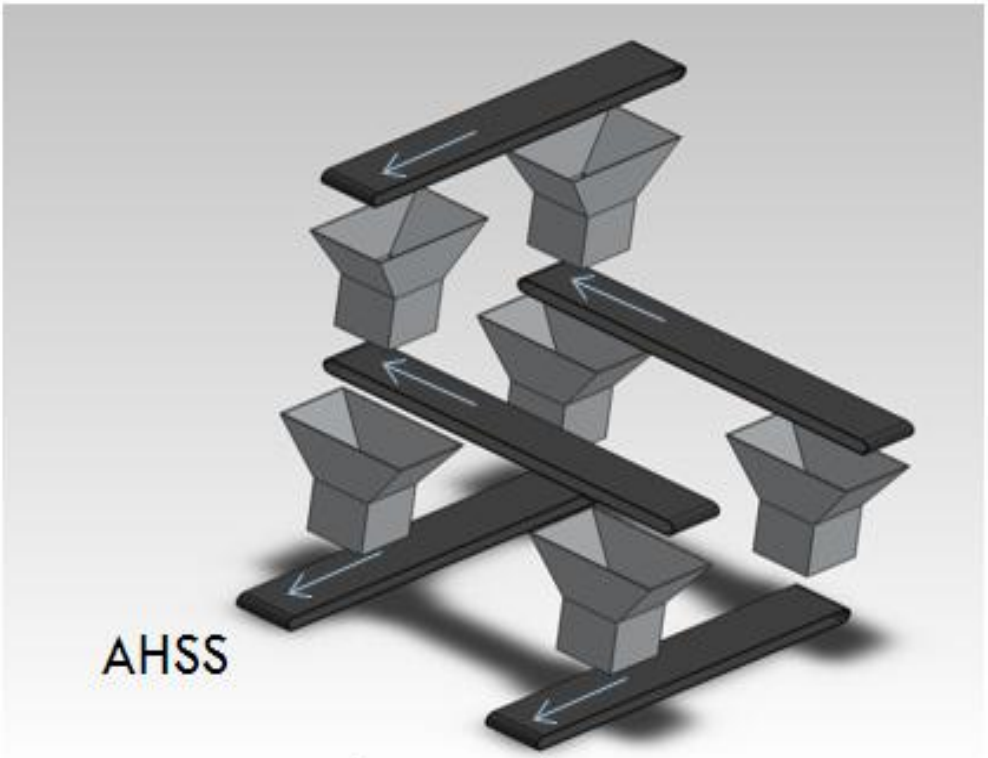
	Seperation	Stamps	Color	Microscopes	Conductivity	Magnetism	Density
Separate correctly	+	+	+	+	0	+	0
Cost	0	0	-	-	0	0	-
Effiency	-	-	-	-	+	+	0
Area Needed	0	0	0	-	-	0	-
Amount of Change	0	0	0	-	-	0	-
Workers needed	-	-	-	-	+	+	0
Totals:	-1	-1	-2	-5	0	3	-3

After coming up with all the ideas, we needed a way to distinguish which one was the best, so we came up with criteria to differentiate them. The first was if the design could separate the metals correctly. We weighted this criteria heavier than all the rest. The next criteria was the cost. If the price for the company was going to be exceptionally high to implement the idea then we gave it a negative point. However, if it was not going to be high, we gave it a zero. The following criteria was efficiency. Some of our designs were far more efficient than others. Another criteria we put was the area needed to implement the idea, meaning if the recycling plant was going to have to add on to their property. One more criteria was the amount of change from the processes currently being used. Lastly, the number of workers that the firm would need to hire factored into the table. Through all these ideas, we added up all the points and found that magnetism was the best design.

5.0 Detailed Design

We selected magnetism as our final design. For this design, Arcelormittal would need to have a very large magnet and a conveyor belt wrapped around it. On one side of the magnet, there would be a very strong magnet. This is the side that would pick up the metal that needs to be sorted. The metal would then be attracted underside of the magnet. The conveyor belt would then move the metals to the side where the magnets got weaker. As the magnet gets weaker, the AHSS will not be as strongly attracted and will be dropped into a chute. The other metal that is not AHSS will still be on the belt on the underside of the magnet. Eventually the force of gravity will overcome the magnetic force that is holding this metal on it and the scrap metal will fall into a chute. The following diagrams are pictures of how our design would be implemented. The first diagram shows the magnetic belt which is a close up version of the top belt in the solid works diagram, which is the second diagram. As seen, there are two chutes below the magnetic belt, one for the AHSS and one for the plain steel. The metal is dropped through the chute and onto the conveyor belt which drops it again for a clean separation of the metals.





Other Steel

6.0 Conclusions

Our selected design, the magnetism design, is successful to a great extent. The magnetism design would efficiently separate the metals, which was our main goal. With more precise calculations and money for research our design has the potential to be very effective. In addition it wouldn't take many workers. The only thing that would need to be done would be to purchase the machine and then hire an extra worker or two to monitor it. Also, it wouldn't take up a lot of space. The recycling facilities are already very large, so a machine this size may seem large, but in comparison, Arcelormittal would easily find room to put it. Fitting these different criteria allowed our design to satisfy the project objectives. It is a unique design that not many people have thought of. It has great potential to change the way metal is recycled.

7.0 References

KUZIAK, R. "Advanced High Strength Steels for Automotive Industry." *ARCHIVES OF CIVIL AND MECHANICAL ENGINEERING*. N.p., n.d. Web.

Kuvin, Brad F. "The Rapid Advancement of Advanced High-Strength Steels." *Metal Forming Facts*. 31 Mar. 2011. Web.

Schlömann, Ernst. "Separation of Nonmagnetic Metals from Solid Waste by Permanent Magnets. I. Theory." *Journal of Applied Physics*. Web.

Smitty. "Archives for List-of-vehicles-with-boron-and-uhss." *List Of Vehicles With Boron And UHSS*. Web.

Wagoner, Robert H., and George R. Smith. "Advanced High Strength Steel Workshop." The Ohio State University, 31 Oct. 2006. Web.