The market size for auto aluminum stamping scrap in 2014 was 104 million pounds and is expected to grow to 586 million pounds in 2020 and 904 million pounds by 2025. It requires 10x less energy to recycle aluminum than to produce it. Aluminum must be separated into 9 series prior to recycling. Currently, aluminum is shipped overseas to be hand-sorted.

Our goal is to create a machine capable of automatically sorting 20 million pounds of aluminum scrap per year into 9 separate alloy series.

• Our final design mounts directly onto a conveyor belt to sort two parallel, single-file lines of aluminum scrap into nine discrete alloy series. As the aluminum travels down the belt, it is identified, and a system of pneumatic actuators mounted perpendicular to the belt travel will push the scrap pieces into their respective bins.

• Scrap that does not belong to any of the nine series will simply fall off the end of the belt to be discarded.

• The actuators used are SMC double action air cylinders with a stroke length of 6” and a extension force of 60 lbf at 75 psi.

• The cylinders extend to push the scrap off and then retract to get ready for the following scrap piece.

According to calculations in MATLAB, we needed 29.6 lbs of force to push the maximum size piece of aluminum scrap (0.037ft³) off the belt. Our cylinder exerts 60 lbf when operated at 75 psi. Furthermore, after testing, the machine proved to be more than capable of pushing a piece of this size off.

According to calculations in MATLAB and finite element analysis in SolidWorks, the stainless steel arms are more than capable of withstanding the stress of pushing a 0.037ft³ piece of aluminum scrap off the belt.

• The 304 stainless steel arms have a yield stress of 31.20 ksi. The maximum stress experienced in the arms due to the largest size scrap piece is 21.74 ksi.

• In addition, the tests proved the arms could withstand pushing large pieces of aluminum of the belt, such as the one pictured on the right.

This machine is capable of sorting over 42 million pieces of aluminum per year. If all pieces were the maximum size, the machine is capable of sorting 86.6 million lbs per year, running 24/7.

This project at nanoRANCH is supported by Phase I and Phase II contract from Department of Energy ARPA-E.

It will be commercialized and installed in several aluminum scarp sorting facilities across the US.

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