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Utilization of Waste by Preparing the Product from Swarf Forging of Alloy Steel (16MNCR5)

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ABSTRACT: The aim of thesis is to prepare the product from swarf forging of alloy steel (16MnCr5). This thesis is an example of how the waste fraction can be transferred from waste to a resource that can be used in other industrial processes. It offers both environmental and economic benefits. Swarf forging gives better control, environmental credits, cost savings an increased margins. Swarf collected from lathe, milling, drill or any other cutting machine is cleaned by degreasing, pickling and acid pickling. Preliminary heat treatment is done to eliminate the work hardening, moisture content and impurity content. Swarf can be continuous, discontinuous or powder form. After collection of swarf, put in mild steel tube for compression. Compression of swarf is done by hydraulic press. The force is applied on piston which is inserted in tube. After compression, swarf which is in form of cylinder is taken out. After this heat the samples are heated and forged with the help of manual hammers or with help of hydraulic hammer. After forging hardness, density and microstructure are checked. The values indicate that product made by swarf forging can be used for low load application like door handles, hangers etc. Swarf forging is a method for empowering material utilization in order to reduce the loss of revenue involved in producing low value swarf in machining operations.

Key words: Swarf forging, alloy steel, waste utilization

I. INTRODUCTION

The new age has added sustainability requirement and the concept of green production as appended criteria of competitiveness. The high standard of living enjoyed in the developed world depends on the use of engineered materials to provide shelter, sanitation, medical equipment, consumer appliances, and communications and transport systems. Steel possessing many properties relevant to such uses and being relatively cheap, are widely used to provide these services. Useful properties of steel include high strength and stiffness and a high melting point. Steel is ductile, making them ideal for structural applications and allowing forming operations to create a range of products. Alloying and post-solidification thermo-mechanical processes can vary the strength and ductility of steel. Steel is likely to remain widely used as the relatively high cost and embodied carbon of alternatives limits the potential for material substitution (WSA, 2008). International Energy Agency projections are that steel production will roughly double (IEA, 2008a) between 2006 and 2050, driven largely by demand from developing countries. The major problems that plague the Steel Industry today includes: Steel Production Remains Depressed, Steel Price Decline, Steel Major Cut Output, Steel Sector Seeks Global Pact, Steel Sector Energy Consumption.

Now days it is common that large amount of swarf (cut-chips) created during the production of components. Then this swarf is sold at a low price by weight which contains coolant solvents (water + oil). This process is unavailable and is often treated as waste management, give companies little or no return. On the other side engineering face escalating waste disposal charges and pressure from legislative bodies to reduce their impact on environment. To mitigate the environmental pollution and meet legislations byproduct utilization by swarf forging can act as a best solution for such a problem. Keeping all this in mind this work was undertaken to provide a better way which gives better control, environmental credits, cost saving and increased profits . This project is an example of how the waste fraction can be transferred from waste to a resource that can be used in industrial process. It offers both environmental and economic beneficial activities that create such collaboration are strategically important.

II. METHODOLOGY

Swarf collected from different machines like lath, planner, bend was cleaned thoroughly. Degreasing is done to remove grease and oil which are commonly found on the surface of machined swarf.

This is actually carried out by the aid number of special of reacting substance. A number of solvents are available for degreasing. Some of them are organic, which dissolves the adherent grease. The first requirement in a degreasing solvent is that it should be low in cost and easily obtainable. It must be capable of efficiently eliminating every form of oil, wax, tar and pickle smut. After cleaning the swarf was put inside the mild steel container fro compression. Then compression was done by hydraulic press which applied force of 60 tones. After compaction the swarf was ejected from mild steel tube/cylinder. Through the lower end of the container had a welded joint, the lower end of the container had to be cut to eject the compacted swarf. After this heat treatment was done to 60% of its melting point for 45 min. forging was done by hydraulic hammer which applied maximum force200 tons. Properties checked include: Hardness, Density and Microstructure.

The trials might have varied in terms of the extent to which these steps were implemented. This was basically done with the aim of studying the importance of each step.

III. RESULTS AND DISCUSSION

Three samples were prepared and the studies were done on density of the swarf product, hardness of swarf product and microstructure.

A. Density

Density of swarf product: the effect of compaction and the forging was studied and the results are shown in Table 1.and Table 2. Forging was done by hydraulic hammer with the load of 150-200 tones.

B. Hardness

This study found that forging has a profound influence on hardness of product. The hardness of cast product was found to be decreased up to 74.8 from 180 when measured on B-scale.

Table 1: Density (□) after Forging.

Sample Number	Height(h)	Diameter(d)	Volume(v) = 3.14*d^2*h/4	Weight(w) Remains same	Density (□)= w/v
1	.6cm	4.6cm	9.966cm^3	65gm	6.52gm/cm^3
2	.53cm	4.7cm	9.190cm^3	67gm	7.29gm/cm^3
3	.57cm	4.5cm	9.06cm^3	68gm	7.5gm/cm^3

Table 2.

Sample number	Weight(w)	Volume(v)	Density(d) = w/v
1	65gm	18.84cm^3	3.45gm/cm^3
2	67gm	20.096cm^3	3.333gm/cm^3
3	68gm	19.596cm^3	3.47gm/cm^3

Table 3: Comparison of swarf and cast product.

Properties	Swarf Product	Cast Product
Density	7.10gm/cm^3	7.8gm/cm^3
Rockwell Hardness number on B – scale	74.8	180

C. Microstructure

Microstructure is the small scale structure of a material, defined as the structure of a prepared surface of material as revealed by a microscope above 25× magnification. The microstructure of a material (such as metals, polymers, ceramics or composites) can strongly influence physical properties such as strength, toughness, ductility, hardness, corrosion resistance, high/low temperature behavior or wear resistance. These properties in turn govern the application of these materials in industrial practice. Microstructure at scales smaller than can be viewed with optical microscopes is often called nanostructure, while the structure in which individual atoms are arranged is known as crystal structure (Fig.1,2).

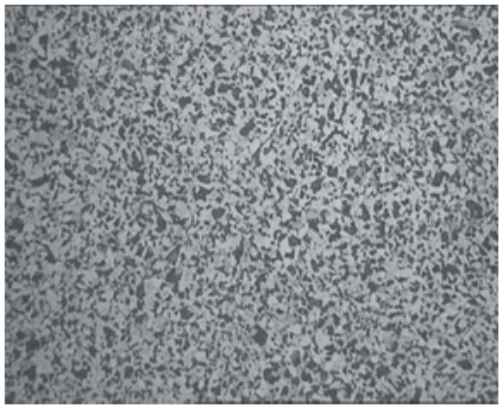

Fig. 1.

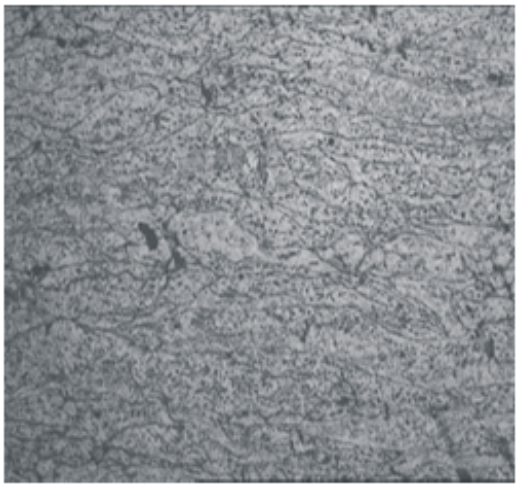

Fig. 2.

IV. CONCLUSION

By this technique we can reduce the waste of metal industries to a large extent but the product made by this technique cannot use for high load applications where we need high strength. This technique also helps to reduce carbon emissions. But to make bigger products we need very big dies approx 9-10 times larger than final product. If we increase force during compaction then we need bigger dies. Ejection of swarf just after compaction is difficult because sometimes chips attached to the tube/cylinder during compaction. Hardness comes out was half of cast product which is very low. Very less research has been done in this field there are no. of points which need to be explore. This field could change the whole face of metal industries.

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