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RESEARCH ARTICLE

POTENTIALS FOR UTLISATION OF POWER METALLURGY-ECONOMY

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ABSTRACT

Recent developments in the technology of the power metallurgy process includes powder production, powder consolidation and sinterings and attainment of high performance properties of metals and alloys direct outcome of the technological advances. latest developments in "green compaction, sintering or pressure sintering of preforms and the forging, rolling or extrusion techniques for final consolidation of such preforms. Quality powder in tonnage quantities at low cost make p/m process inheareently attractive. Economic availbility of tonnage quantities of quality powders makes powder metallurgy production feasibilities of metals &alloys applications to larger components demonstrates "Potentials for utilization of powder metallurgy components with high performance propertities with less weight and low cost in processing is unique for powder materials utilization in economical way. Powder metallurgy is competing with the conventional manufacturing methods by offering greater economy with better performance

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INTRODUCTION

Matetrials are so important in the development of human civilisation that the historions have identified early periods of civilizatin by the name of most significiently used materials e.g: stone age, bronze age. This is just observation made to showcase the importance of materials and their impact on human civilisation. It is obvious that materials have affected and controlling a broad range of human activities through thousands of decades. There has been tremendous progress over the decades in the field of materials science and engineering ,innovation of new technologies, and need for better performances of existing technologies demands more and more from the materials field. It is evedient that new materials/ technologies demands are needed to be environmental friendly. Global market for powder metallurgy (pm) parts is projected to reach us $15.7 billion by 2020, driving emerging applications in transportation, construction and mechanical engineering sectors. The growth in the market is also expected to benefit from the recovery of the global automotive industry and optimistic outlook for commercial aerospace industry. Advancements in powder metallurgy parts such as "hot is ostatic pressings, metal injection moulding and additive manufacturing are driving opportunities in the metal powder market. In order to consider manufacturing as a system, we need to look beyond the conversion of raw materils and processes which lead to finished products. The understanding of the manufacturing system as a whole, helps in identifing, which process parameters and functions of the organisation are important. This helps to make decisions about the economical way of producing end products. There are several factors which are usually considered in taking a final and revelent decesion about the best way of producing the desired end product. A manufacturing system can be considered as a simple input output system at the first stage. The functions involved in an organisation for the design, planning and manufacturing of the product. The manufacturing system incorportating all the above aspects of holistic approch.

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MATERIALS AND METHODS

Steel powder production

The availbility of suitable quality powders in tonnage quantities at low cost makes the powder metallurgy process inherently attractive. In as much as the powder propertiesin themselves are basic to all the processing which follows and to the final attainment of properties in the consolidated material. Each of these process produces powders o f different characterstics, such as partical size, partical shape, porosity and purity that influence the character of those consolidation processes, and the properties of the final material.

Powder processing method

Atomization: atomization provides the best combination of economy and powder properties. Atomization process utilizes a stream of high velocity air (or) water to disintegrate a stream of molten metal to particles (1-4microns). A number of different nozzels arrangements are employed and these variations comprise some of the various property aspects in the industry. This applies particularly to the water automization (domtar) process combined economy and quality of powder properties. Powder metallurgy is a material processing technology to creare new materials and parts by diffusing different metals powders as raw materials ingredients through the sintering process.

Non ferrous metals production

The first large –scale production of tungstun in ductile property renaissance of powder metallurgy, because this invention was the basis for the development of the moderan incandicsent lamp industries. The development of ductile tungsten lead to large scale production of refractory metals such as tungstun, molybdneum, contact materials such as tungsten-copper, tungsten-silver, porous products and cemented carbides. These could not be produced by coventional techniques. Other possible methods to production of powders by secondary refining of metals from scrap, losses, waste and other resources. Most recovery of many non-ferrous metals in the powder form from the low grade ore, scrap and other resources.

Products created by powder metallurgy using basic process

Powder forging

Powder forging, a hybrid technology involving the production of a preform by conventional press/ sinter powder metallurgy followed by consolidation to close to full density using closed –die hot forging powder forging has developed a proven capability in series production for the delivery of high strength and performance.

Powder compaction

Compaction process develops higher green density. In higher pressure, cold compaction preasures from 600mpa max to 1,000mpa consequent enhancement to green density. Warm compaction, tooling being heated to around 150 degree farhian heat scale, increased temperature reduces flow stress of the iron powder and allows green density upto 0.2g/cub.cm. Warm die compaction tooling is pre-heated, to around 95 degree f. High velocity compaction involves high velocity hammering blows.

Sintering

Sintering of fine powder additions e.g; the' ultra fine" nickel elemental additions in ferrous powder metallurgy. Post – sintering densification process has involved selective surface densification through local cold deformation. Powder metallurgy materials processing by 1.Casting 2.Forging, 3.Stamping, 4.Metal injection moulding and machinging involves ceramics materials, nuclear materials, diamond tool, magnetic materials, high density materials (W,MO), cemented carbide, frictional materials, tribological part materials.

Preform for gong technology-economics

Powder preform forgings requires co-ordinated efforts in three areas of

A) The input powder
b) Design and fabrication of preform.
C) Design and execution of the forging operation.

Powder alloy choice is based on the final required properties, but also on powder characterics, relative to processing such as "green compressibility" and sinterability, relate to powder parts levels, and particle size and shapes. Green compaction operation, die design is unique to the final geometry. Compressibility depends, significantly on the lubricants employed as well as powder characterstices. Sinterng temperature is designed to give precise sintered dimensions, with sinterins atmosphere, chosen to minimize oxidation and enhance the sintering operation.

The preform is forged to provide degree of metal flow either by,

1. Conventional methods which produces some degree of "flash" within the die component
2. By minimium deformation methods by which the metal flows to fill the die cavity without "flash".

Second method, minimizes the machining required, but the larger amount of obtaing high performance properties. The forging temperature is based largely on obtaining the metal flow required, and the press tonnage available, but also minimizing the extent of die wear which is an important economic factor. Large sizes, such as "green compaction" handling the "green compact" and die cost, might be solved by "isostatic compaction technique.

Table 1. Factors for powder pre- form

Factors for powder preform forging.

1.Alloy choice
1.green compaction- a)die design b)lubricants

1.Techniques –a) conventional forging b) minimum Deformation

2.Particle characterization 2. Sintering atmosphere
–a) temperature 2. Die design
3.impurity requirements 3. Sintered characterisation
3.temperature
4.availability 4. Forged
Characterisationa) properties

B)consistency

Cost

Design of die, not only unique to the particular part geomentry, but also to the green comprssibility characterstices of the particular powder employed.

1. Once die design is fixed, the powder characterstices must be held constant.
2. Forging is also accomplished with a single stroke of the press.
3. Minimum deformation forging technique is employed, for which the extent of the deformation is calculated to obtain properties, without formation of" flash".
4. The machining requirments thus are minimized.
5. Only finish machining required is noted.

Principal economices of the powder metallurgy are in the savings in material and machining, rather than number of forging steps alone. Original estimates of the savings for the this component were of the order of 50% for the mass production quantities. Mouldings (or) "green "pressing of the preform is a key step, in the powder preform forging process, since it must produce a preform of dimensions and density, precisely suited to the final forging operation.

Powder metallurgy approach–attainment of high performance properties

The fundamental utilisation of the powder metallurgy approach in attainment of high mechanical properties of steel particularly tensile strength, ductility & impact strength. Ductility is given by the percent enlogation (or) percent reduction in area of the tensile sample. Impact strength is given in terms of foot-ponds of energy required to facture the standard v-notch charpy test. Tensile strength and ductility of the powder metallurgy forgings are equivalent to those of the forgins rom wrought material. As received powder deficiency in ductility and impact resistence can be overcome by additional pre treatment of the powders by the hydrogen enabled material to be equivalent to that of the forged wrought material. Pre-treatment consisted of heating the powder in hydrogen at 1600 degree farihn heat scale for about 20 minutes which normal cycle of powder metallurgy processing.

Table 2. Impact resistence -effect of hydrogen treatment on forged steel

Impact resistence –effect of hydrogen treatment on forged steel

1.Conventionl wrought forged material - 56% by charpy v-notch impact test at rc30.

2.Powder metallurgy forgings from powder treatment in h2 at 1600degree f - 46% to 59% by charpy v-notch impact test at rc30.

In recent years, by improving the fabrication technique, sintering aluminium powder(sap) of more homogenious nature and better structural ability at elevated temperatures have been produced. Best known of the dispersion –strengthned metals in td (thorium dispersion nickel). This is superior to most superalloys at temperatures over 1900 degree farihn heat scale. Superimposing the effect of the solid solution sterengthing and dispersion strengthings, it is possible to improve the temperature properties of the materials. In aluminium with magnisium addition upto 5% and oxide content upto 12%, it is possible to achive room temperature tensile sterengh value of 60,000 to 65,000psi,while maintaing high temperature properties of sap. The quantity of the metal powder, determine the physical and mechanical properties of the product, it is important to use a suitable well processed powder for each type of product for, depending on the purpose for which it is used. Full density properties are available traditional powder forged materials, which are based on unalloyed base iron (or) low alloys with nickel and molydbnem additions.

Powder metallurgy forgings –dimensional tolerances

1.Tolerance within 0.002 inch per inch on a diameteral tolerance.
2.Zero draft on surfaces in dies.
3.Tolerance in pressing direction is 0.004 inch on length tolerance s upto 2 inches.

Cost parameters of the powder metallurgy forgings:

The principal cost factors in the area of steel powder metallurgy forgings:

Powder cost production method relate directly to the alloy content.

5.1) Powder :8% to 17% by weight
Moulding cost depends upon the press operating cost and press speed
5.2) Moulding :2.5% to 5% per part
The cost sintering is reflected by the mass to be sintered ,which based on furnace capacities and operations costs
5.3) Sintering :10% by weight

The cost of the forgings depends upon press

5.4) forgings:4% to 5% per blow.
Die costs are a major factor, which vary in size, complexity and a need for redressing as a result of the die wear.
5.6) die costs : $2000% to $15,000 each.

Total cost : redressing required for every 20,000 part production.

Redressing and replacement 2% to25% per part.
The associated costs vary wildf, and may add from 2% to 25% to the cost per part.

Conventional for gongs losses 35% to 40% of the input material, so that the yield is only about 60% to 65%.in powder metallurgy part production, yield is about to 97% & maximum. The machining labour as a major contributing saving factor varies with the complexity of t

Conclusion

Manufacturing industries, today, encompass a dimension scale of more than fifteen orders of magnitudies. The design and manufacturing of huge machinery, ship and space crafts on one side while nano and pico technology on the other side of the dimension scale, highlights the challenges ahead for the engineers and technologosts. With advent of Technology for new materials, energy sources, manufacturing technology, decision making and management techniques are being developed. These unflod lot of opportunities for the scientific and academic ferternity. At the same time, newer challenges in the form of environmental and other issues, put stringent requirments on the technology. Global competition, the thrust on quality and demands for the higher productivity are some of the challenges before the present industrial and manufacturing units.

- Encouraging gains in global manufacturing powder metallurgy, signals as optimistic outlook of metal powders.
- Automobile industry is the largest end –use industry in powder metallurgy parts.
- Market witness a shift towards finer powders & advanced powder metallurgy parts.
- Increasing volume of consumption of powder metallurgy materials in aero –engines &land based gas turbines spares growth.
- Mechanization of agricultural drives, demands for powder metals based components in agricultural machinery products.
- Growing demand for mining and construction equipment boosts growth in the powder metallurgy parts.
- Market analysis estimates forcasts for 2014-2020 &historic review 2007-2008, geographic regions covered us, UK, Canada, Germeny, Japan, Spain, Russia, Asia-Peacific & rest of the world.

REFERENCES

Dr. P. Rama Krishnan; Indian institute of technology: Bombay - "recent developments in powdermetallurgy of non- ferrous metals.

Hitachi powdered metals co.ltd – "Recent technology of powder metallurgy and applications "- Tadayuki tsutsui.

Powder metallurgy review –High density, High performance powder metallurgy structural Metallurgy structural parts

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