

A CONCEPTUAL DESIGN OF PATTERN TO REPLACE INVESTMENT CASTING

THESIS SUBMITTED IN THE FULFILLMENT

FOR THE DEGREE OF

Bachelor of Technolgy

In

Mechanical Engineering

By

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**Department of Mechanical Engineering
National Institute of Technology, Rourkela**

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Under the Guidance of

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CERTIFICATE

This is to certify , the thesis titled “ **Conceptual design of pattern to replace investment casting**” Submitted by **Lokanath Behera, Roll No: 109ME0360** in partial fulfillment of requirement for the **Bachelor of Technology – degree in Mechanical Engineering,**

National Institute of technology, Rourkela , is carried out under my supervision.

According to my knowledge the matter embodied in this thesis has not been submitted to other universities or institutes for the award of any degree .

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Mechanical Engineering

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ABSTRACT

This project represents the loose-piece and piece-wise pattern manufacturing process as a new conceptual design of pattern to replace precision investment casting process. An object was prepared using the loose-piece pattern process ; and compared with the precision investment casting process. The analysis of results indicates that the investment casting process is a very slow and more expensive process due to the involvement of large manual labour and also due to the lost of wax in the process . The investment casting process is limited by the size and mass of the casting . While the loose-piece pattern is a low cost process and also a less time consuming process as compared to the precision investment casting process . The precision investment casting process attains better surface finish than the loose-piece pattern process . Although the loose-piece pattern process does not attain a better surface finish than the precision investment casting process ; nowadays good quality grinding machines are available , hence using good quality grinding machines a better surface finish can be achieved in the loose-piece pattern process.

KEYWORDS :-

1. PRECISION INVESTMENT CASTING
2. LOOSE-PIECE PATTERN

INTRODUCTION :-

PRECISION INVESTMENT CASTING :-

In precision investment casting, wax is used for making the pattern and after the mold is made, the mold cavity is prepared by melting the wax.

The precision Investment casting is a casting process that produces casting of high quality. It is a very useful casting process as it provides casting in geometry's that could not be machined or forged, or where machining can be considered as a waste of material.

precision Investment casting is generally used for the compressor blade and turbine blade production; that are used in aerospace and also as well in the production of the turbines that are land based. This casting process produces components with accuracy, versatility and integrity in high performance alloys and also in variety of metals. A higher degree of confidence is required for the shell itself because of the nature of the casting for the required alloys. This happens because of the cost or expenses incurred when the failure of the shell occurs during

casting ; which is unacceptable in terms of both lost material and furnace down time.

In studies of this kind the combination of Quick Cast techniques and stereolithography processes are used in the prototype pattern building and in the building of the investment casting shells . Those are built in a honeycomb-like manner with strong outer skin to produce the required shape . If the pattern were solid, As compared to sand casting or die casting; the precision investment casting is a more expensive casting process per unit .

The precision investment casting is an oldest known metal-forming technique . It is also known as lost-wax casting or lost foam casting . The precision investment casting is an industrial process . The precision investment casting is the modernised form of the investment casting ; in which certain steps have been eliminated . The pattern of wax are used in the investment casting process .

The precision investment casting process is the process where the mould is prepared around an expandable pattern . The first step is the preparation of pattern , by injecting molten wax , under pressure of 2.5 Mpa into a

metallic die , which has the cavity of the casting to be made . The second step is to eject the pattern from the die , after solidifying the wax . Then the cluster of wax patterns are attached to the gating system by applying heat , in step three . Then the mould is prepared in step four by dipping the pattern into a slurry made by suspending fine ceramic materials in a liquid such as ethyl silicate or sodium silicate . In step five , dry refractory grains such as zircon arte stuccoed on this liquid ceramic coating . The sixth step in the process is to remove the pattern from the mould to melt the pattern . The seventh step includes the pouring of molten metal into the mould under gravity , under slight pressure by evacuating the mould first . The last step includes the cleaning of the casting in order to remove the signs of the casting process , usually by grinding .

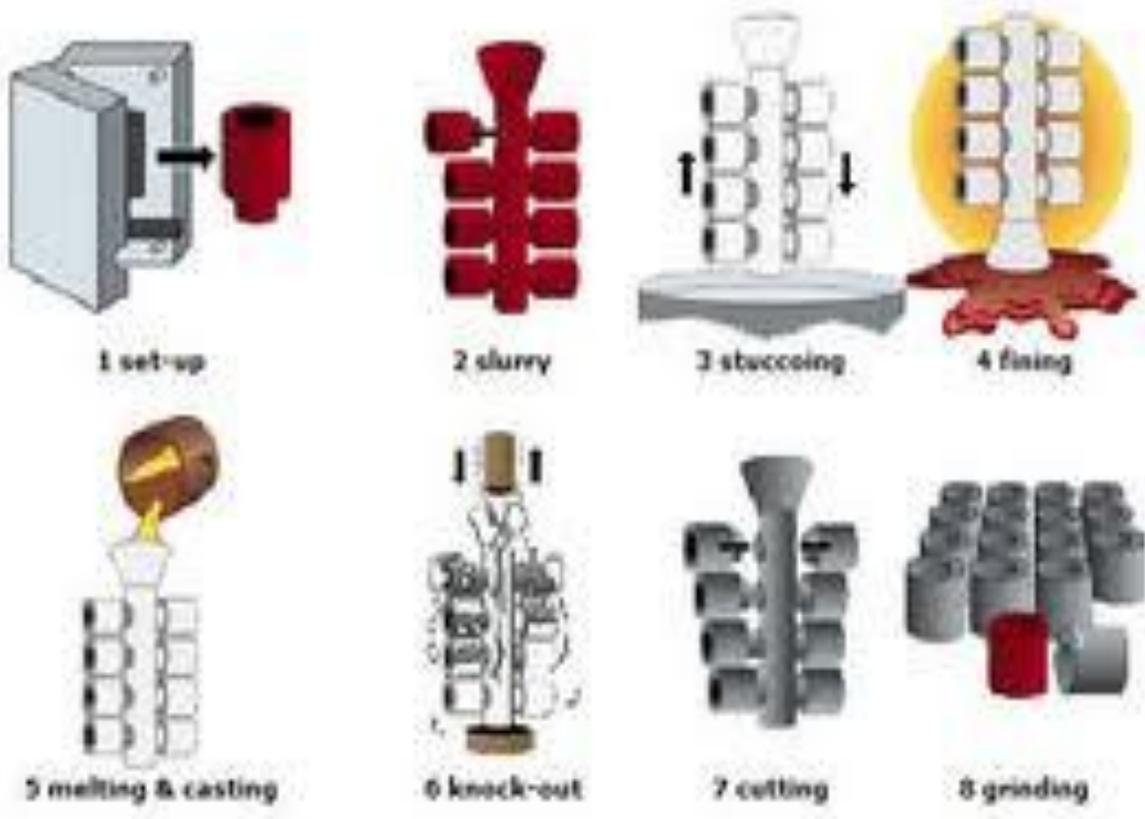


FIG :- Investment casting process

LOOSE-PIECE PATTERN :-

Loose piece pattern is the type of pattern used when the contour of the part is such that with-drawing the pattern from the mould is not possible .Hence during moulding ,the obstructing part of the contour is held as a loose piece by a wire . After the moulding is over ,first the main pattern is removed and then the loose pieces are recovered through the gap generated by the main pattern .

In most of the cases ,small projections or overhanging portions are found in this type of casting . These portions or projections make it difficult in withdrawing the pattern . Hence these portions or projections are made as the loose pieces.

The loose pieces i.e, the portions or the projections are attached loosely to main part of pattern .

A pattern is different from the casting ;even though the pattern resembles the casting to be produced .

A pattern is different from casting in regarding to the terms of the certain allowances which are required in producing correct dimensions and the correct shapes and also in eliminating the minor details that are too small or complicated

in order to be produced .

Complexity of the casting along with the shape of the casting , casting material , the pattern , etc depends on the design of the pattern .

Some of the castings requiring patterns that have parts with the back draft in a way such that it cannot be produced into the split patterns .

In these kind of patterns parts containing the back draft are produced into loose pieces which can be removed separately from mould after main pattern has been removed .

Loose pieces are held initially , during moulding , in a place with the help of the slides or with the help of the pins . When the main body is withdrawn in vertical direction , loose pieces are left inside the mould .

Then the loose pieces are withdrawn sideways and then pulled up through the cavity which the main piece makes up .

The loose piece patterns are of a low pattern cost and hence have the advantage over other patterns .

But normally the loose piece pattern takes longer time in moulding as compared with other patterns .

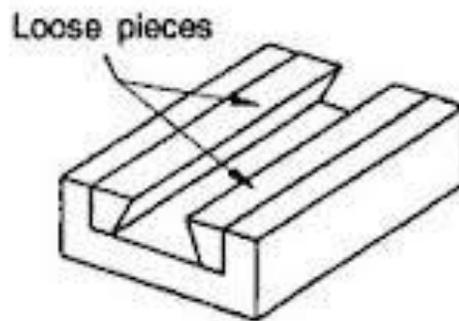
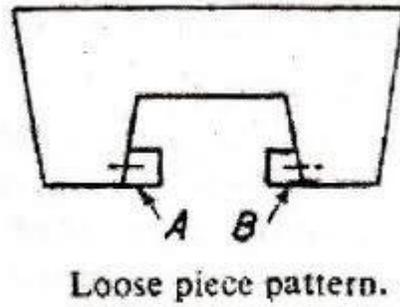


FIG :- loose pieces of pattern

EXPERIMENTAL METHODOLOGY :-

WORK TO BE DONE :-

CARPENTRY

MATERIAL :-

WOOD PIECE

JOB TO BE DONE :-

COMPRESSOR BLADE USING LOOSE PIECE PATTERN

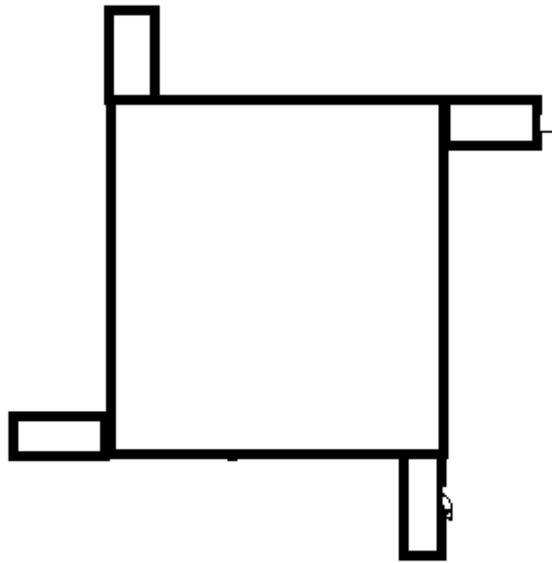


FIG :- 2D VIEW OF AN COMPRESSOR BLADE

WHOSE MAIN PART IS OF 50*40*30 mm AND THE BLADES

ARE OF 20*10*15 mm

OBJECTIVE :-

The objective is to manufacture the compressor blade by sand casting i.e, by loose piece pattern .

EXPERIMENTAL PROCEDURE :-

A wooden piece of 90*60*30 mm was taken and using the carpentry tools , the shape of the compressor blade was made that is of :- main or middle part (50*40*30) mm

Blades (20*10*15) mm

Now the compressor blade was manufactured by sand casting method i.e., by loose piece pattern process .

The blades were held by a loose piece by a wire and were connected using cope and drag . After moulding was over first the main pattern was removed and then the blade part was recovered through the gap generated by the main pattern .

Thus the mould was prepared and was ready for pouring of molten metal into it . Thus the compressor blade was prepared by sand casting method i.e, by loose piece pattern method .

CONCLUSION :-

The analysis of results indicates that the investment casting process is a very slow and more expensive process due to the involvement of large manual labour and also due to the wax lost in the process . The investment casting process is also limited by the size and mass of the casting . While the loose-piece pattern is a low cost process and also a less time consuming process as compared to the precision investment casting process . The precision investment casting process attains better surface finish than the loose-piece pattern process . Although the loose-piece pattern process does not attain a better surface finish than the precision investment casting process ; nowadays good quality grinding machines are available , hence using good quality grinding machines a better surface finish can be achieved in the loose-piece pattern process.

RESULT :-

1. Loose piece Pattern method is not an Expensive process
2. Investment casting is limited by the mass of the casting
3. Investment casting is a slow process .
4. Also the investment casting is limited by size of casting .

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