Evaluation of physical and mechanical properties for various wax blend patterns

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Abstract- Excessive application of investment casted precise and complex components in aerospace and automobile industries pushes developments in near net shape investment casting process. As investment casting is lost wax process, the wax pattern manufacturing is the significant part of process chain of ceramic mould development .Improvement in properties of wax pattern is needed for successful production of mould as well as casting. In present research work, approach will be made to develop pattern with the mixtures of various commercial wax and novel additives to enhance better physical and mechanical properties of wax blend as well as final pattern. In present work focus will be made on the properties tensile strength, volumetric shrinkage and surface finish as these properties directly affects the accuracy achieved for mould cavity as well as the final casting. Comparison of these properties for various wax blend combination will help for development of effective wax pattern.

Index Terms- methods of improving properties, properties of wax blend patterns, progress in investment casting

I. INTRODUCTION

As investment casting process is a "lost wax" method , in which wax is lost and given shape is made by doing design and manufacturing of that shape mould and the mould broken by two shapes and getting our required shape .The investment casting process is used now in every where in the recent times .The application like aerospace ,power generation ,gold and diamond industries ,gear manufacturing where the accuracy is very much important.

If we increase the properties of physical and mechanical for the wax blended patterns ,it will helpful for the applications where greatest accuracy is needed and because of accuracy the investment casting components are rejected .Now in the recent years the further additives and machining processes are available sothat rejection rate for components isreduced .But it will definitely improve the cost of the manufacturer.

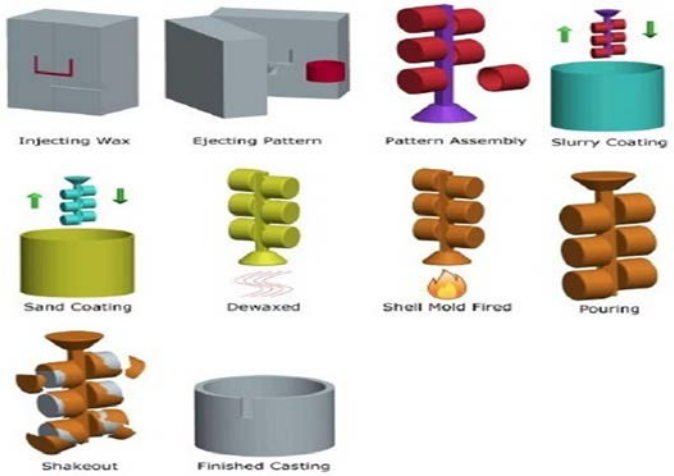

Fig. 1 process chain for the investment casting

As shown in the figure , how the process is occurred in the investment casting is explained. Injecting wax , ejecting pattern ,pattern assembly ,slurry coating ,sand casting ,dewaxed ,shell mold fired ,pouring ,shackout ,finished casting. As the process chain is so much long and it is suitable for complex components .If the properties we want to improve the above process is very much important.

Generally waxes are used for blended pattern is paraffin wax,microcrystalline wax,carnuba wax,bees wax etc.for the we taken the paraffin wax,irani wax,rosin wax,mointain wax,microchip wax.addtives used for the process is generally upto 0to20 percent.

II. LITERATURE REVIEW

1 From progress in investment casting the topics Process parameters , wax used in investment casting , additives used in investment casting are useful for the experiment

2 From Research of optimize wax pattern in investment casting by using different form of waxes the topics Bee wax , carnuba wax , montan wax , paraffin wax , china wax , additives are used in investment casting by different percentages.

3 From **Recycling of pattern wax in the investment casting dewaxing the topics PARAFFIN WAX,CARNUBA WAX,MICROCRYSTALLINE WAX,EXPEIMENTAL INVESTIGATION,MESUREMENT OF DIFFERENT PARAMETERS LIKE TENSILE STRENGTH,VOLUMETRIC SHRINKAGE,SURFACE ROUGHNESS**

4 from Physical properties of blend oxidized paraffin wax the topics Thermogravimetric analysis , mechanical properties , surface tension measurement , flow rate measurement.

5 from Analysis the properties of lost wax processes and its use ability the topics Composition of investment casting wax , categories of investment casting wax , recycling , quality maintained in the investment casting

6 from **Simulation of wax pattern dimensions for accuracy improvement the topics Numerical simulation of wax solidification was found useful to calculate and control the shrinkage of wax pattern to improve the accuracy.**

7 from Investment casting wax influencing which eliminate wax pattern defects the topics Pattern wax composition , wax preparation , injection characteristics , influences . corrosion defects.

8 from Wax defects in investment casting the topics Wax deformation of pattern , trapped air , powder and silicon spray

Wax Preparation Experimental methodology :-

As shown in the table 1 the waxes used for this experiments are Paraffin wax, Rosin wax, Irani wax, Microchips wax, Mointain waxetc. For the blend 1 Paraffin Wax, Irani wax and additive as a charcoal powder and the %preposition of each constituent is 62,48 and remaining additives are there. For **the blend 2 Irani wax , Rosin wax and additive as a charcoal powder and the %preposition of each constituent is** 40, 51 and remaining % is additives. **For the blend 3 Rosin wax, Mointain wax and additive as a charcoal powder and the %preposition of each constituent is** 42, 56 **and remaining is additive.** For **the blend 4 Mointain wax, Microchip wax and additive as a charcoal powder and the %preposition of each is** 54,40 and remaing is additive. **For the blend 5 Paraffin Wax, Microchip wax and additive as a charcoal powder and the %preposition of each is 30,65 and remaining is charcoal powder.There is a shape of die. Die is a complex shape sothat the properties improve will directly affect for the complex shape product. In the figure no.3 it is acomplex shape pattern is shown.There is a Tga analysis for the wax blend pattern which shows it is remains same upto temperature 250 and then drops and then remins constant.**

Sr no.	Name of wax used
1	Paraffin wax
2	Rosin wax
3	Irani wax
4	Microchips wax
5	Mointain wax

Table 1:- Types of waxes used

Blend no.	Paraffin Wax	Irani wax	Rosin wax	Mointain wax	Microchip wax
1	62	28	0	0	0
2	0	40	51	0	0
3	0	0	42	56	0
4	0	0	0	54	40
5	30	0	0	0	65

Table 2 : Wax blend mixture constituents.

Fig.2 shape of the die.

Fig. 3 wax blend pattern.

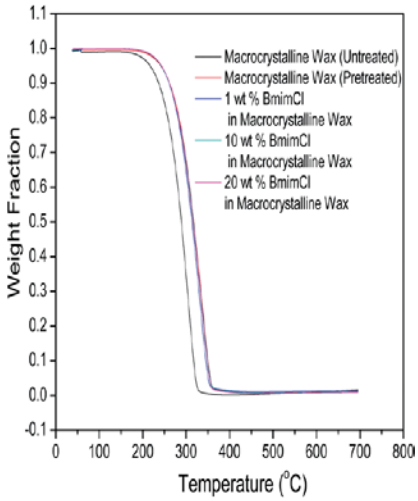

Fig.4 Tga analysis for the wax

Methodology Applied :-

Volumetric Shrinkage :-

The volumetric shrinkage is calculated as follows:

i) Apply a coating of grease on two halves of die to make it leak-proof from water and align the two halves of die together.

ii) Fill the die cavity with water and measure its volume with the help of a measuring flask. (*vd*)

iii) Fill water in a measuring flask and note the initial reading (*vi*).

iv) Place the wax patterns made inside the measuring flask, volume rises and take the final reading. (*vf*)

v) The difference between the two readings (*vf* - *vi*) gives the volume of pattern.

vi) The percentage of volumetric contraction of the pattern is given by the following expression

Volumetric coefficient of thermal expansion is calculated by the relationship as shown.

$\Delta v = \beta\ vi\ (Ti - Tf)$

Where, ΔV = change in volume

β = volumetric coefficient of thermal expansion

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vi = initial volume,

Ti = initial temperature.

Tf = final temperature

Surface Roughness :-

Surface roughness is measured by optical profilometer instrument.

Tensile Strength :-

Tensile strength is measured by UTM machine.

Observation Table :-

SHRINKAGE TEST :

TYPES OF WAX BLEND PATTERNS	LENGTH	WIDTH
Die	276 mm	45 mm
Paraffin wax + rosin wax + montan wax	273.5 mm	43 mm
Irani wax + steric acid	273 mm	42 mm
Irani wax	274 mm	43 mm
Paraffin wax + microchips wax + steric acid	275 mm	44 mm

Table 3

SURFACE ROUGHNESS TEST :

WAX BLEND PATTERN	SURFACE ROUGHNESS (Ra)
Paraffin wax + rosin wax + montan wax	I. 0.86 II. 0.84 III. 0.84
Irani wax + steric acid	I. 0.83 II. 0.83 III. 0.84
Irani wax	I. 0.85 II. 0.87 III. 0.85
Paraffin wax + microchips wax + steric acid	I. 0.89 II. 0.88 III. 0.90

Table 4

Tensile strength :-

	Mpa 1	Mpa 2	Mpa 3
Pattern 1	**56**	**58**	**54**
Pattern 2	**50**	**52**	**51**
Pattern 3	**55**	**54**	**55**
Pattern 4	**49**	**52**	**50**

Table 5

SHRINKAGE-LENGTH GRAPH :

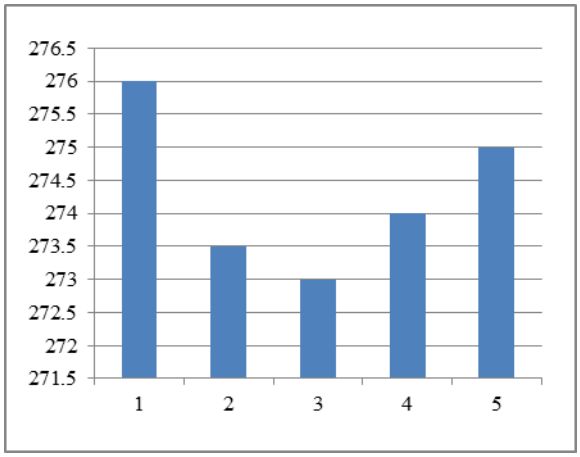
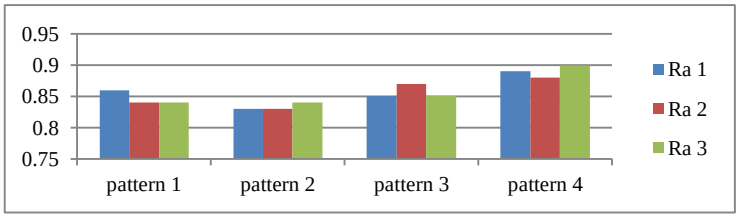


Fig. 5
Surface roughness :-



.F ig.6
Tensile strength

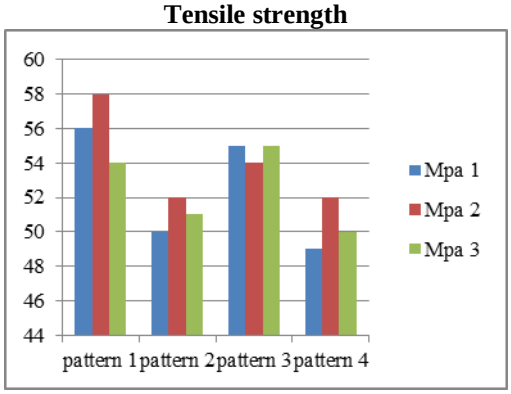


Fig.7

III. CONCLUSION

The following conclusions are drawn out of the experiments conducted on wax blend selection and selection of optimum process parameters :The wax blend 2 with proportion of paraffin wax, microchips wax, montan wax and steric acid gives the better results of linear shrinkage, volumetric shrinkage and surface roughness.The influence of tempreture on the surface roughness of pattern mixtures was observDifferences in shrinkage deformation of patterns according to the type of pattern mixture was observed

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