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DETERMINATION AND CALCULATION OF OPTIMUM CONDITION FOR EXTRACTION OF CENTRIFUGALLY SPUN CASTED PIPE

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ABSTRACT: ***This experimentation utilizes Taguchi Methodology to break down IS - 3989 channel thickness This is a productive system which gives ideal results in least number of trials . The control variables for this examination incorporates pouring temperature , mold turning speed, coolant stream rate .Total 9 test have been led on IS-3989 channels by utilizing configuration of analysis (DOE). L9 orthogonal cluster shaped .After investigating yield variables, ideal thickness was found .A compliance test (ANOVA) was utilized to confirm the outcome which gives critical parameters for radially threw funnels.***

Keywords: Optimization, Centrifugal Casting Machine, Taguchi Methodology, Pipe Thickness, L9 Orthogonal Array, ANOVA, Minitab 17.

I. INTRODUCTION

Casting procedure are the primary procedure to be done in forming the item. For constructional work. In this way step by step the need of the Centrifugally threw funnels are getting higher. Throwing of the cast Iron funnels were finished by the readiness of mold utilizing adapt and drag process, which includes parcel of talented work and the time taken by the sand threw channels were just about 24 hours. Because of this constraint furthermore the no of indistinguishable things were settled in view of the cutoff floor region of the Foundry. This disadvantage has been overcome by applying the radiating throwing process in assembling the cast Iron channels utilized for downpour water and soil water waste . An exploratory endeavor has been made under the direction of my administrator and the Hari Iron Foundry (vrindavan) the individuals who have permitted me to do my study and amylases on Centrifugal Casting framework. Utilizing vault for getting the liquid metal as a crude material for the diffusive throwing machine.it was in the year1805 by A.G. ECKHARD for making the radiating throwing came into the presence and in year 1809 which was licensed.

II. LITERATURE REVIEW

Mahendrakumar gupta ,Sonia, nayak [1] have led the examination on the aluminum compound on the radiating throwing machine to investigate the outward throwing imperfections on their assembling parameters like rate of the mold ,temperature of the liquid metal and the cooling rate. It was found that the pouring temperature of the liquid metal ought to be high to empower it to achieve the most remote point before the cementing begins. While leading the investigation they have advanced parameters of liquid metal 1100o C and the surface temperature ought not surpass between 425oC to 475 o C and the mold pivot was kept in the scope of 800 to 1000 rpm. Christo Ananth et al. [2] proposed a system, this fully automatic vehicle is equipped by micro controller, motor driving mechanism and battery. The power stored in the battery is used to drive the DC motor that causes the movement to AGV. The speed of rotation of DC motor i.e., velocity of AGV is controlled by the microprocessor controller.This is an era of automation where it is broadly defined as replacement of manual effort by mechanical power in all degrees of automation. The operation remains an essential part of the system although with changing demands on physical input as the degree of mechanization is increased.

Anurag kulkarni [4]has did the CFD examination of the radiating throwing procedure to discover the connection between hardening rate and throwing wear. The finish of the examination was that with the expansion in rotational speed the outward constrain acting power following up on the liquid metal likewise expands, which makes the uniform thickness of the funnel and along these lines evacuate the imperfection of sprinkling.

J.M Maker and Rajni [5]have led the near investigation of the sand threw channels and the radiating threw funnels with the impact of the consumption on them. they have done the Metallographic study that how the graphite pieces , chip size and the metallic lattice are in charge of forming the mechanical properties of both the funnels. it was found amid the exploration that the metallurgy of the funnels has significant commitment on the erosion and surface completion. They found that on contrasting and the steel , the additional carbon and silica added to the cast iron brings down the liquefying purpose of the of the metal with respect to the steel it is 1470oC and for the cast iron it is 1150 o C. This distinction makes the cast iron 13 tests of study he simple to cast into channels. In this has utilized Vickers small scale hardness estimation. Nagesh Jamulwar [6] have outlined the covering plate to bolt and open the mold from the inverse end of the pouring, they have taken the SAE-1030 material and to upgrade the ordinary covering plate strong works and the Annoys programming are utilized . as customary covering plate devour 5 to 6

moment of the aggregate assembling lead time. The advanced configuration comprises of the break shoe sort so that the time required has been less for the locking and opening the covering plates. the undertaking has been done at the jaiswal NECO commercial enterprises at outward throwing division. At last the there ideal composed has been affirmed and considered. Hardik.chudhary [7] his theme was the investigation of the tribological examination of the metal by the outward throwing process ,led the test study on the metal (cuzn40pb2) fabricated by the vertical throwing machine utilized for the shrubberies and riggings where erosion and wear assumes and imperative part .In test settings the mold velocity was kept up at 1150 rpm and the pouring temperature was 1050 o C .for 10 , 20, 30 N Load and the sliding separation was kept at 500m and 1000m . After the examinations it was found that by expanding the sliding separation from 500m to 1000m the wear and wear rate was expanded. S.K Paknikar [8]has contemplated the isolation on the D.I (Ductile Iron Pipes) in his theme of exploration creation of nature of flexible iron funnels by the outward castings : to think about the procedure parameters and microstructures .through his exploratory work he has clarified about Banding that is shrinkage porosity and hard games on the surface of the channel, because of the stage change in view of the fluctuating cooling rate.The kind of throwing was barrel shaped shell measurements was width - 500mm and the thickness 30 mm. It was found that the directional cementing from the external skin of the throwing to internal skin of throwing happen. As hardening begins in D.I channels impact of the silicon as the graphitize works and the graphite knobs are framed in the network of the ferrite and partite according to the evaluation of D.I.

III. MACHINES AND EQUIPMENTS

The following machines and software were used in this experimentation:-

1. Centrifugal Casting Machine (Horizontal type)

1.1. Pouring station:

Pneumatic operated pouring platform
forward/reverse Hopper system
Fall chute
Nozzle
Tilting system (Pneumatic)
Runner head adjusted
Hopper stand
Horn, Nozzle, Basin – 1 set for one machine

1.2 Spinning station: (Main drive)

- Heavy base frame
- Structure of main drive complete
- Pair of alloy steel heat treated rollers driven by DC drive. 30HP /40HP DC drive both Siemens Electrical & Electronic control.
- A set of heavy duty bearing blocks & the drives & the idler pulleys.
- Mould cooling arrangement for process requirement.
- Anti-vibrating arrangement of spinning stations.

1.3 Mould spray cooling unit kg:

- Long lancing system with spray nozzle on set per minute.
- Pneumatic position adjusted.
- wear resistance guide.
- Pneumatic spray system.
- Up & Down and Forward / Reverse operation of lancing unit.
- Tanks 75mm, 100mm, 150mm

1.4 Coating material tanks:

The machine consisting of tanks of 90 ltr. Capacity made of s.scelite mixing, Bentonite mixing & pressure tank of coating material such tanks will be fitted with flange mounted electric motors for continuous stirring of coating materials.

1.5 Extraction system:

- Mechanized with electric D.C 5HP motor drive for smooth operations (PLC controlled with gear box)
- Trolley motion (Forward/Reverse) mechanism with Rack-Pinion arrangement.

1.6 Roll off:

A set of fabricated arms with pneumatic controls to support the pipe after extraction.

1.7 Power &control stations:

Power & PLC control panel with drives Siemens make.
Control desk for monitoring the process.
Water pump for mould cooling..

A.8 Tailing:-

- [Size of pipe 100mm →Analysis is done on it]
- Right selections of these parameters will bring out the good surface finish pipe &In less time with less or no pin holes.

2. Cupola Furnace

2.1 Type- D.B.F (Divided Blast Cupola Furnace)

- Designed by PPDC AgraCapacity 2Tonne/HR

- No of cupola : 2
- Height: 40 ft
- Diameter: 4 ft

2.2 Advantages-

- 25-30% reduction in coke consumption
- 50 ^{0}C increase in melt temperature
- 25% increase in melting rate
- Less pollution

3. IS -3989 Material

- Work piece material : Grey cast Iron
- Total no. of specimen : 9
- Shape : Round
- Length : 3 m
- Diameter : 100 mm

3.1 Chemical properties:

- Carbon (C) : 3.5% to 3.7%
- Silica (Si) : 1.8% to 3.75%
  Carbon Equivalent (CE) : 4.3%
- Phosphorus (P) : 0.35 % to 0.45%

3.2 Physical properties:

- Hardness : 230 HBS Maximum
- Density : 7.15 kg/dm^{3}
- Tensile Strength : 180 MPa.
- Melting Point : 933K
- Temperature Resistance :600 ^{o}C
- Material grade : Minimum FG 150 as per IS: 210

4. Thickness Tester (DigitalVernier caliper)

Brand: Mitutoyocorp(Kawasaki)

- Make : Japan , U.S pat – 5.440.501
- Battery:SR 44
- Model No- 6D 6 "esx
- Can measure both in – mm and inch units .

To quantify the thickness of the IS – 3989-1984 channels according to the standard notice in the BUREAU OF INDIAN STANDARDS . The thickness is measured by both computerized and the simple vernier caliper to discover the realness of the information accumulations. The thickness can be tried effortlessly in both mm and in inch sizes of unit upto0.01mm likewise on relying upon the estimation range.

5. Infrared Thermometer

Make: METRO (JAPAN)

- D:S : 16:1
- Accuracy >100 ^{0}C +-2%
- Emissivity :0.1 to 1.0

6. Design Expert Software Minitab 17

This software is used for planning experimental design matrix and analyzing all the responses according to statistical method. Taguchi method cannot judge and determine effect of individual parameters on entire process while percentage contribution of individual parameters can be well determined using ANOVA. MINITAB software of ANOVA module is employed to investigate effect of process parameters pouring temperature of molten metal, mould spinning speed, cooling rate (by water spray).

IV. TAGUCHI METHODOLOGY

Taguchi Method was proposed by Dr. G. Taguchi in the year 1950. In Taguchi technique, the procedure parameters are isolated into two gatherings, for example, control elements and clamor variables. Signal speaks to the impact on the normal reaction while the commotion is a measure of the impact on the deviation from the normal reaction. The S/N proportion is the proportion of the mean (Signal) to the standard deviation (Noise). This proportion distinguishes the ideal level of procedure parameters. A high S/N proportion is attractive as the sign level is much higher than the irregular clamor level that prompts best execution. The computation of S/N proportion relies on upon the quality attributes of the item or procedure to be enhanced. The condition for figuring S/N proportions for "bigger is better" and "littler is better".[9,10,11]

V. ANALYSIS AND DISCUSSION OF RESULTS

Experimental determination of the effects of the various process parameters as Pouring temperature, mould spinning speed and coolant flow rate on the performance measures as optimizing minimum thickness of IS-3989 pipes.

Table.2 L9 OA with measured e $_{min}$

Exp. Run	Pouring Temperature (^{0} C)	Mould Spinning Speed(rpm)	Coolant Flow Rate (Lt/min)	Minimum Thickness of Pipe(mm)
1	1275	900	15	3.25
2	1275	950	20	2.74
3	1275	1000	25	3.46
4	1300	900	20	3.48
5	1300	950	25	3.07
6	1300	1000	15	3.92
7	1325	900	25	3.68
8	1325	950	15	2.42
9	1325	1000	20	3.58

VI. SURFACE ROUGHNESS MEASUREMENT AND ITS ANALYSIS

Taguchi technique is an uncommon configuration of orthogonal exhibits that is utilized to ponder the whole outline element space with just a little number of analyses. In this study, three diffusive throwing parameters (pouring temperature (A), mold turning speed (B), and coolant stream rate (C)) with three distinctive levels (Table 1) are tentatively built for the throwing of IS 3989 CI funnels. In Table 1, the three levels of these outward throwing parameters are distinguished. The Orthogonal Array L9 for the investigations are represented in Table 2. These scopes of parameters are chosen on the premise of examination paper surveys and generation subtle elements of IS-3989 radial threw funnels (spun) at BABULAL BAJAJ IRON FOUNDARY VRINDAVAN (MATHURA).

Table.1 Process Parameters and Three Levels

Process Parameters	Parameter Designation	Levels		
		1	2	3
Molten Metal Temperature (^{o} C)	A	1275	1300	1325
Mould Spinning Speed (rpm)	B	900	950	1000
Coolant Flow Rate(L/min)	C	15	20	25

The layout of the L9 Orthogonal Array is shown in table 2. Each run will have one value collected for minimum thickness of pipe(e min). Therefore, a total of (3*3) =9 data values were collected for pipe thickness, which are conducted

Calculation of S/N Ratio for e $_{min}$:

The Signal to Noise ratio is found by using Taguchi"s value (Mean) and the „noise" represents the undesired value (standard deviation). Thus, the Signal to Noise ratio represents the amount of variation available in the performance characteristic. Here the desirable objective is to optimize the response variable e $_{min}$. Hence **larger-the-better** types S/N ratio was applied for converting the raw data for as larger values of e $_{min}$ as desired. The values of S/N ratio and mean corresponding to different experiment tests have been tabulated in Table 3.

Table.3Taguchi OA Design for S/N Ratio:e $_{min}$

Exp Run	Pouring Temperature (^{0} C)	Mould Spinning Speed (rpm)	Coolant Flow Rate (Lt/min)	Minimum Thickness of Pipe(mm)	S/N Ratio
1	1275	900	15	3.25	10.237
2	1275	950	20	2.74	8.7550
3	1275	1000	25	3.46	10.781
4	1300	900	20	3.48	10.831
5	1300	950	25	3.07	9.7428
6	1300	1000	15	3.92	11.865
7	1325	900	25	3.68	11.317
8	1325	950	15	2.42	10.680
9	1325	1000	20	3.58	11.077

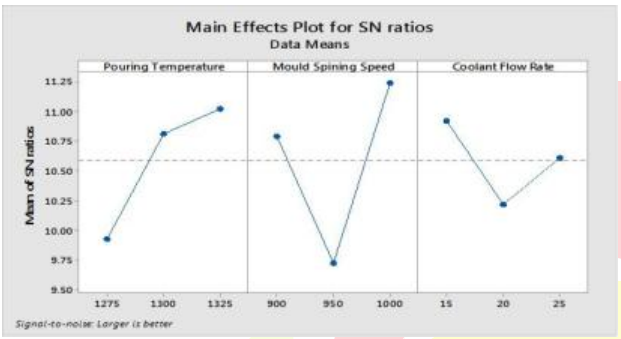

Fig.1.Main Effect Plot for S/N Ratio: e $_{min}$

C. Investigation of Variance Using Adjusted SS for tests

The target of the examination of change (ANOVA) is to discover, which outline parameters fundamentally impact least thickness of funnel (e min). A superior vibe for relative impact of the different components can be acquired by the decay of the change, which is ordinarily known as the investigation of fluctuation (ANOVA). Table Show the aftereffects of change investigation of Signal to commotion proportion information for means. The most influencing information variable is Mold Spinning Speed for least thickness of IS 3989 channels. The goal in directing ANOVA is to decide the relative greatness of the every component on target work and to assess the blunder fluctuation. In Robust Design, ANOVA likewise used to look over among numerous options the most suitable quality attributes and flag to commotion proportion for a particular issue. Examination of fluctuation used to research which machining parameters influenced the trial values essentially. In the present examination, the ANOVA and the F-test connected to inspect the exploratory information. In this test the parameter or the mix of parameters which have P esteem under 0.05 those influence fundamentally. In this test rate commitment of the Mold Spinning Speed is Maximum. The most influencing element is Mold Spinning Speed and after that pouring temperature for least thickness of IS-3989 funnels. ANOVA Table (Values are Obtained by Software Minitab) for:

S/N Ratio

Since as prior expressed ANOVA help us to perceive which parameter is essential for us after writing audit taking after ANOVA table is gotten for e min. Minitab 15 programming is utilized for measurable estimation reason.

S = 0.150111 R-Sq =95.30% R-sq(Adj)= 81.19%

D. Determination of the Optimum Value of Input Parameters for e_{min}

Fig.1 demonstrates three charts, which comprise the bend between mean of sign to clamor proportion information and the info parameters (control components) demonstrates the bend between the mean of mean and control variables. The estimations of the charts and the motivation behind utilizing the S/N proportion as an execution estimation are to create items and the procedures inhumane to commotion components. The S/N proportion demonstrates the level of the anticipated execution of an item or procedure within the sight of clamor elements. Process parameters setting with the bigger sign to clamor proportion dependably yield the ideal quality with least change. Thusly, the level that has a bigger quality decides the ideal level of every variable.

Here, in fig.1. level 2 of pouring temperature (1325 o C) has the most extreme S/N proportion esteem, which demonstrates the ideal circumstance in term of mean quality. Likewise, the level 3 of the mold turning speed (1000rpm) and the level one of the coolant stream rate (15 Lt/min) have additionally demonstrated ideal state of S/N proportion and mean worth. Subsequently the ideal outline for the bigger least thickness of channel will pour temperature (1325 o C), mold turning speed (1000rpm) and coolant stream rate (15 Lt/min).

E. Confirmation Test for e_{min} *:*

Once the optimal level of the process parameters is selected, the final step is to predict and verify the improvement of the performance characteristic using the optimal level of the process parameters. The estimated S/N ratio using the optimal level of the process parameters can be calculated by selecting the optimum level of design parameter the final step is to verify and confirm the obtained (predict) parameter to those found through experimental work to access the quality characteristics of casting process.

Predicted values:

Optimized values obtained by Minitab software. Experimental values:

VIII. CONCLUSION

This experimentation utilizes Taguchi Methodology to break down IS - 3989 channel thickness This is a productive system which gives ideal results in least number of trials . The control variables for this examination incorporates pouring temperature , mold turning speed, coolant stream rate .Total 9 test have been led on IS-3989 channels by utilizing configuration of analysis (DOE). L9 orthogonal cluster shaped .After investigating yield variables, ideal thickness was found

.A compliance test (ANOVA) was utilized to confirm the outcome which gives critical parameters for radially threw funnels.

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