International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 05 Issue: 10 | Oct - 2021 ISSN: 2582-3930

EFFECT OF CHEMICAL COMPOSITION IN BRASS CASTING CORRING & SEGREGATION PROBLEM

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Abstract

In the present study the chemical composition checked with the help of spectrometer. Actually, Jamnagar is known as brass engineering cluster, and in this cluster, there are 100+ entrepreneurs doing sand casting of brass. When I interacting with them about casting defect, they say "color avi gayo" i.e., technically coring & segregation of brass casting had been done. Therefore, in order to solve this problem, present study involving effect of copper, zinc proportion in copper & copper alloy brass casting by spectrometric analysis, and carried out trials to maintain composition near to Muntzs metal, and this will lead to solving the problem where β brass is solute to α+β brass phase. Experimental method to solve above mentioned problem is Design of experiment – Taguchi method and measuring coring & segregation by % of rejection caused by this defect.

Keywords: β brass, α+β brass, Muntzs metal, Sand Casting

1. Introduction

Casting which also known as founding is one of the earliest metal shaping methods. It means the pouring of molten metal into the refractory mould then allowing it to solidify. After solidification removing of part from the mould either by breaking the mould or ejecting the mould part. Casting has been most often selected over other manufacturing methods, because of the following reasons. Any complex shape with internal cavities or hollow sections can be cast using casting. Big parts can be formed in one piece. Materials which are difficult to process can be utilized by casting [1].

Demand for copper and brass, especially in Muntzs metal continues to increase in the applications of the battery terminals, building hardware, cycle tube valves; it requires an increase in mechanical and technological properties with the addition of suitable alloying elements [2]. Despite increasing demand, finished or semi-finished products often experience rejection due to various defects and imperfections due to coring & segregation of Muntzs metal products that arise during various stages of manufacturing [3]. Product defects also occur due to the standard requirements of the metallurgical properties (such as grain size) unaccepted, mechanics (such as yield strength, tensile strength, hardness, and impact) and technology (such as formability, and machinability) standards to improve the properties of brass materials must be done first by repairing the main alloying elements and additional alloying elements. Previously in brass, especially in additional alloying elements: lead (Pb) and Bismuth (Bi); but today, the world community has issued strictly restrictions to overcome the harmful effects of lead and provide a driving force for the development of free lead brass alloys [4]. Types of Brass

There are many different types of brass, each with a slightly different chemical composition. Each type of brass has its own name, qualities, and uses. For example:

Red brass, not surprisingly, is warmer in color than other brasses. It also is a particularly strong type of brass.

Cartridge brass (also referred to as 260 brass and yellow brass) is best known as an ideal metal for shell casings. It is most often sold in sheet form and easily formed and worked into desired shapes.

330 brass is particularly useful in tubing and poles because it is both workable and machinable. Fire poles are a common use for 330 brass.

Free machining brass, also called 360 brass, is relatively high in lead, making it easy to cut and shape. It often is used to make items such as rods and bars.[5]Naval brass, also called 464 brass, is highly resistant to corrosion and thus ideal for use in seawater

2. Coring & Segregation Defect.

In sand casting of brass (Muntzs metal Cu 60% & 40% Zn) is done at Jamnagar Brass parts engineering cluster by sand casting method where source of raw material is brass scrap available as honey scrap contain less percentages of copper, utensil scrap possesses higher copper content. Melting of scrap is done in open type of crucible furnace of 100 kg, 200 kg, 225kg size.

Now when solidification of as cast brass product in to the sand mould, there is separation of copper and zinc at core of casting and looks like dendritic structure while taking a cross section as shown in figure 1.

Figure 1: Eencircled red shows defect in Brass casting shows coring & Segregation

3. Experimental trials

While caring out experiment following parameters are constant and variable parameters are brass scrap and zinc addition.

Melting furnace: 100 kg open type pit furnace
Row material: Brass scrap, foundry return
Type of casting: Sand casting
Mould type: Cope & Drag type
Pouring temperature: 1100 to 1200-degree C
Pouring time: 20 seconds
Flux: slax 30 from Foseco by 1% of charge
Deoxidation: DS Tube from Foseco
Transfer medium: Hand ladle
Ladle size: 40 Kg
Sand size: 60 AFS
Product: Cycle tube valves
Batch size: 80 Kg per trial

There are total 9 trials carried out in order to get desired result. Variation in parameters is using various scrap and variation in zinc addition.

After each trial spectrometer analysis is caried out, in order to observe chemical composition mainly copper, zinc and other elements.

4. Detection of coring & Segregation defect:

As per statistical quality control randomly 5 % of sample collected (i.e. 5 kg cycle tube valves) and tested against eddy current testing, and based on that % of rejection were counted.

5. Methodology

By design of experiment taguchi design approach is considered in which there are four factors viz. copper percentages, zinc percentages, Lead percentage and casting rejection were studied as follows.

Table 1: Taguchi Design Summary

Taguchi Array	L4(2^3)
Factors:	3
Runs:	4

Columns of L4(2^3) array: 1 2 3

Table 2: Taguchi Design Summary

Taguchi Array	L4(2^3)
Factors:	3
Runs:	4

Columns of L4(2^3) array: 1 2 3

Table 3: Trial Vs Chemical Composition & % rejection

TRIAL NO.	Cu	Zn	Pb	TEMPERATURE degree C	REMINDER Sn, Sb, Fe	%REJECTION
1	57	38	1	1100	10.2	10.2
2	57	37	2	1150	11.3	11.3
3	57	39	3	1200	13.5	13.5
4	58	38	2	1200	14.0	14
5	58	37	3	1100	15.0	15
6	58	39	1	1150	17.0	17
7	59	38	3	1150	6.0	6
8	59	37	1	1200	5.0	5
9	59	39	2	1100	0.1	0.1

By using Minitab software, result of spectrometric analysis is entered in software and design the taguchi experiment and obtaining main effect of plot Means.

By inspecting 5 % of batch size randomly as per Statistical quality control with the help of eddy current tester % of rejection is as shown in table1 caused by coring & segregation defect.

Taguchi Analysis: %REJECTION versus COPPER, ZINC, ... TEMPERATURE

Table 4: Response Table for Signal to Noise Ratios

Smaller is better

Level	COPPER	ZINC	LEAD	TEMPERATURE
1	-21.834	-19.521	-19.294	-1.761
2	-23.684	-19.243	-7.995	-20.411
3	-3.181	-9.072	-20.564	-19.836
Delta	20.504	10.449	12.569	18.650
Rank	1	4	3	2

Table 5: Response Table for Means

Level	COPPER	ZINC	LEAD	TEMPERATURE
1	12.400	10.433	11.000	7.550
2	15.333	10.000	8.467	11.433
3	3.700	10.200	11.500	10.833
Delta	11.633	0.433	3.033	3.883
Rank	1	4	3	2

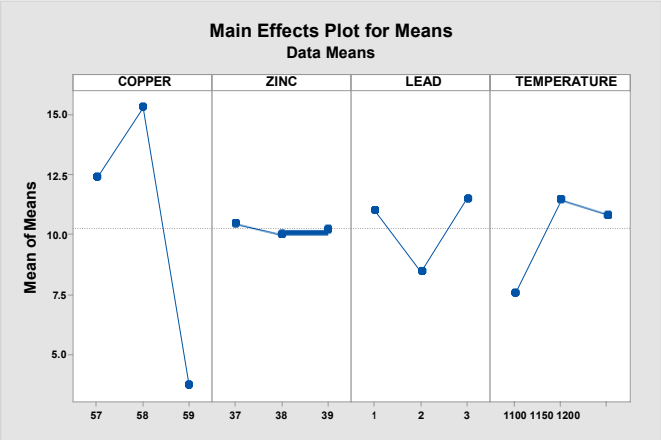

Figure 2: Main effects plot for means

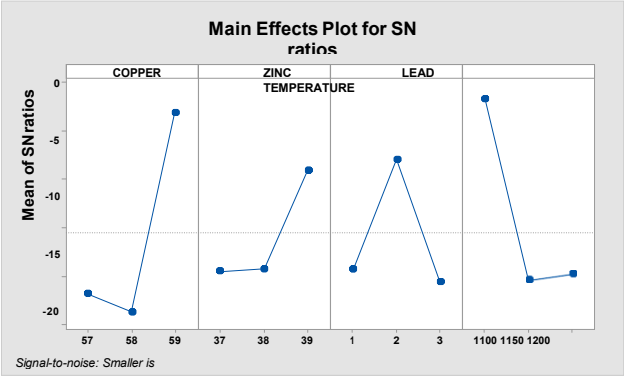

Figure 3: Main Effects Plot for SN ratios

6. Optimize trials

Based on taguchi analysis new 9 trial were carried out under same condition except maintain chemical commotion during time of melting and taking spectrometer analysis as follows.

Table 6: Spectro analysis & % rejection

Trial No.	Cu	Zn	Pb	Reminder Sn,Sb, Fe,Al	% Rejection
1	57	37	1	5	
2	57	38	2	3	10.25
3	57	39	3	1	11.23
4	58	37	2	3	14.3
5	58	38	3	1	12.36
6	58	39	1	2	10.2
7	59	37	3	1	8
8	59	38	1	2	6
9	59	39	2	0	0.5

Table 7: Taguchi Design Summary

Taguchi Array	L16(4^ 3)
Factors:	3
Runs:	16

Columns of L16(4^ 5) array: 1 2 3

Table 8: Taguchi Design Summary

Taguchi Array	L9(3^3)
Factors:	3
Runs:	9

Columns of L9(3^4) array: 1 2 3

Taguchi Analysis: % Rejection versus Cu, Zn, Pb

Table 8: Response Table for Signal to Noise Ratios

Smaller is better

Level	Cu	Zn	Pb
1	-20.611	-20.584	-17.868
2	-21.706	-19.206	-12.434
3	-9.201	-11.720	-20.303
Delta	12.505	8.865	7.870
Rank	1	2	3

Table 9: Response Table for Means

Level	Cu	Zn	Pb
1	10.740	11.150	8.100
2	12.287	9.537	8.350
3	4.833	7.310	10.530
Delta	7.453	3.840	2.430
Rank	1	2	3

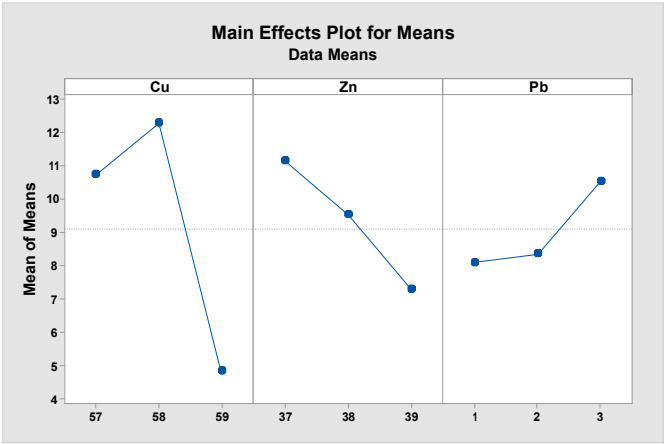

Figure 3: Main effects plot for means

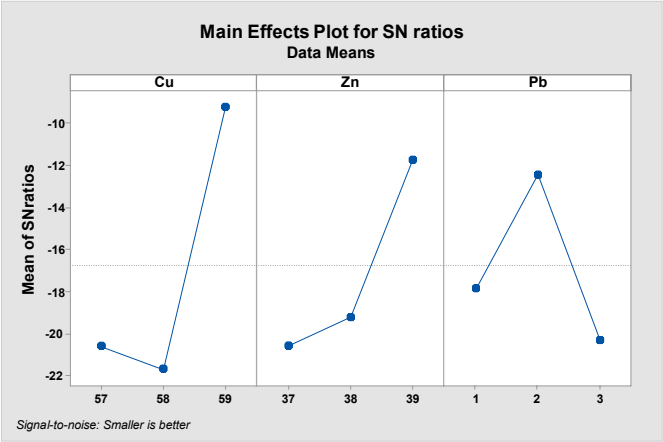

Figure 4: Main effects plot for SN ratios.

Result & Discussion:

By carring out taguchi analysis as per first nine trials we can find that chemical composition in trial 9 of table 3.

Conclusion:

Based on trial as shown in table no 6 by maintaining the chemical composition Copper nearer to 59 to 60%, Zinc to 38 t 39%, Lead 1 to 3% results in less rejection due to coring and segregation defect.

Acknowledgement

I am very thankful to Mr.K.K.Shaw, Director, Jamnagar Brass Cluster Development Project, EDII, Ahmedabad for contributing in coring and segregation problem of jamnagar brass cluster small and medium scale enterprises(SMEs)

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Biographical notes

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