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EFFECT OF CALCIUM UPON ALUMINIUM MOLTEN METAL DENSITY

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Abstract: Aluminium molten metal used widely for making aluminium product. This study discusses an investigation into the metal composition effect upon the metal density. But other factor also involved inside it. In this experiment we changed metal composition and other factor remains constant than we find out the effect of composition element upon density.
Keywords: Brass, manganese, silicon, magnesium, zinc, chromium, nickel

I. INTRODUCTION

Rotary degassing of liquid aluminium alloys is a widely used commercial process to control levels of hydrogen, alkali metals and inclusions in the melt prior to casting. A comprehensive theoretical understanding of the kinetics of aluminium degassing has been established in the past twenty years. Whilst there have been some published experimental tests of degassing theory in molten aluminium, in many cases key pieces of information are not reported or determined, such that a critical assessment of the underlying theory is compromised. Similarly, practical implementation of such understanding in usable shop-floor process models has met with difficulties owing to lack of knowledge concerning some key parameters. These include the stirring intensity dissipated in the melt, and its relationship to the average gas bubble size, and the mass transfer coefficient at the free surface of the melt. A selection of different degassing rotors have been characterised in a comprehensive experimental program. The study resulted in Internet based simulation software for the degassing processes in foundries; the elements of this simulation are presented. Density is the mass of an object per unit of volume. In other words metals with the same mass will occupy less or more space depending on their density. A metal with a high density will occupy a smaller space than a metal with a low density. A metal with a low density will occupy a larger space than a metal with a higher density. Density- Mass divided by volume. M=D/V
Aluminum (also known as aluminium) is the most abundant metal element in the earth's crust. And it's a good thing , too, because we use a lot of it. About 41 million tons are smelted each year and employed in a wide arrange of applications. From auto bodies to beer cans, and from electrical cables to aircraft skins, aluminum is a very big part of our everyday lives.
Properties:

- Atomic Symbol: Al
- Atomic Number: 13
- Element Category: Post-transition metal
- Density: 2.70 g/cm^3
- Melting Point: 1220.58 °F (660.32 °C)
- Boiling Point: 4566 °F (2519 °C)
- Moh's Hardness: 2.75

Characteristics:
Aluminum is a lightweight, highly conductive, reflective and non-toxic metal that can be easily machined. The metal's durability and numerous advantageous properties make it an ideal material for many industrial applications.A major breakthrough in aluminum production came in 1886 when Charles Martin Hall discovered that aluminum could be produced using electrolytic reduction.Until that time, aluminum had been rarer and more expensive than gold. However, within two years of Hall's discovery, aluminum companies were being established in Europe and America.During the 20th century, aluminum demand grew substantially, particularly in the transportation and packaging industries.Although production techniques have not changed substantially, they have become notably more efficient. Over the past 100 years, the amount of energy consumed to produce one unit of aluminum has decreased 70%.

II. PROPOSED EXPERIMENTAL SET UP

Melt Treatment or liquid prior to pouring in to die plays an important role towards the quality of the casting in term of microstructure, strength, mach inability, freedom from porosity, etc. the melt treatment comprises of
1. Slag/ dross coagulation and their removal using cover fluxes /drossing fluxes.
2. Degassing using tablets or nitrogen gas
3.Determination of hydrogen content.
4. Grain refining
5. Modification
2.1 EQUIPMENTS USED
2.1.1 MTS (DEGASSING MACHINE).
The main used of degassing m/c is to remove hydrogen content from melt. In this machine flow rate, degassing time, rotor r.p.m set early and these are changeable also. In this machine a rotor lance is also used in which inert gas coming from cylinder and its goes inside the melt.
2.1.2 N2 OR ARGON GAS
These two types of gas basically used in degassing process because of low cost and good output. In this process basically inert gas is used. The pressure range is 2-3 bar used according to other factor.
2.1.3 LADLE
Ladle is a vessel contains molten metal inside it. Its capacity 450-500 kg. The molten metal tapping in side the ladle for

degassing purpose and then pouring inside the die.

2.1.4 DENSITY INDEX TESTER:- Two sample made one in air and another in vacuum . Air sample solid in air and vacuum sample 80 Mbar pressure and 4 minute time for solid. Density index tester measure gas content in the sample . Computer also connected with this density index tester for keeping record.

Density Index

- $$\text{Density of Sample} = \frac{m_{(air)}}{(m_{(air)} - m_{(Water)}) \times \text{Density}_{(water)}}$$

- $$\textbf{Density Index (DI)} = \frac{\text{density}_{(air)} - \text{density}_{(Vaccume)}}{\text{density}_{(air)}} \times 100$$

DI value : min 0.5, max 3
Vaccume value: 80~82mbar
Vaccume time ~ 4minutes

2.1.5 SPECTRO METER

The spectro meter is used for the composition checking of the metal. The spectro meter analysis the element percentage of the given sample. The spectrometer required room temp. 22-28 degree. The metal sample granding first and then checking the composition.

2.1.6 MOLTEN METAL COMPOSITION

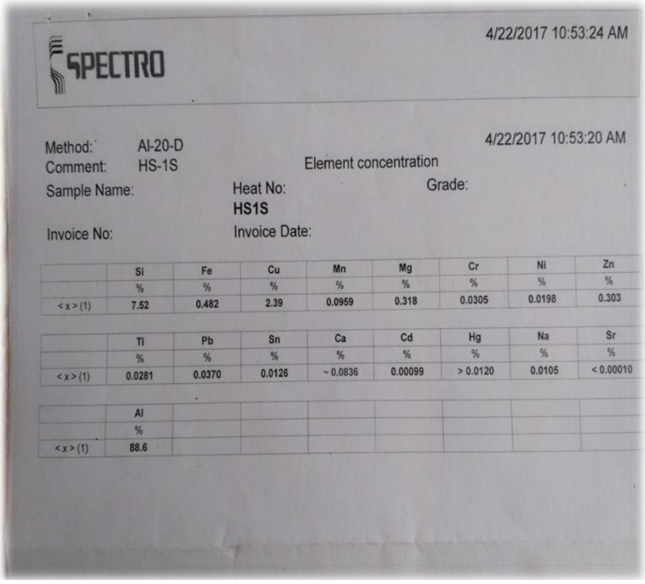
Composition of aluminium molten metal

ELEMENT	%
ALUMINIUM	89.5
SILICON	6.44
Fe	.55
Cu	2.52
Mn	.147
Mg	.468
Cr	.012
Ni	.0095
Zn	.268
Ti	.019
Ca	.450
Sr	.010

TOOL FOR METAL CLENAING AND SAMPLE MAKING.

1. Skimmer- it's used for metal cleaning and dross removing from metal.
2. Spoon with long handle it's used for sample taking from ladle.
3. Die is used for making sample for checking metal composition.
4. Grinding machine is also used for sample grinding for metal composition checked.

Element concentration: The element concentration is shown by the following data table in which different % of different components are shown.



SPECTRO 4/22/2017 10:53:24 AM

Method: Al-20-D 4/22/2017 10:53:20 AM
Comment: HS-1S Element concentration
Sample Name: Heat No: HS1S Grade:
Invoice No: Invoice Date:

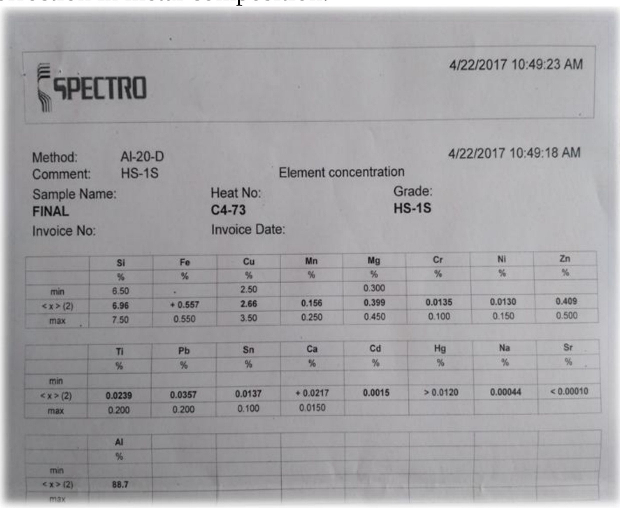
	Si	Fe	Cu	Mn	Mg	Cr	Ni	Zn
	%	%	%	%	%	%	%	%
< x > (1)	7.52	0.482	2.39	0.0959	0.318	0.0305	0.0198	0.303

	Ti	Pb	Sn	Ca	Cd	Hg	Na	Sr
	%	%	%	%	%	%	%	%
< x > (1)	0.0281	0.0370	0.0126	~ 0.0836	0.00099	> 0.0120	0.0105	< 0.00010

	Al
	%
< x > (1)	88.6

Fig.: element concentration

Additions Calculation:- (Req. Element % - actual element %) x total metal weight/100 . It is the formula used for the correction in metal composition.



SPECTRO 4/22/2017 10:49:23 AM

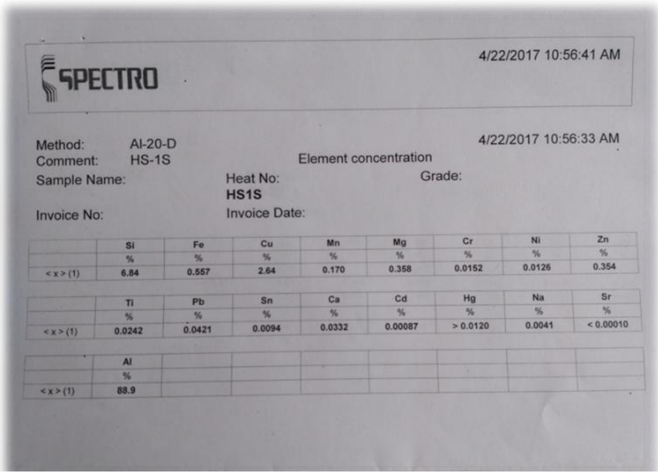
Method: Al-20-D 4/22/2017 10:49:18 AM
Comment: HS-1S Element concentration
Sample Name: FINAL Heat No: C4-73 Grade: HS-1S
Invoice No: Invoice Date:

	Si	Fe	Cu	Mn	Mg	Cr	Ni	Zn
	%	%	%	%	%	%	%	%
min	6.50	.	2.50		0.300			
< x > (2)	6.96	+ 0.557	2.66	0.156	0.399	0.0135	0.0130	0.409
max	7.50	0.550	3.50	0.250	0.450	0.100	0.150	0.500

	Ti	Pb	Sn	Ca	Cd	Hg	Na	Sr
	%	%	%	%	%	%	%	%
min								
< x > (2)	0.0239	0.0357	0.0137	+ 0.0217	0.0015	> 0.0120	0.00044	< 0.00010
max	0.200	0.200	0.100	0.0150				

	Al
	%
min	
< x > (2)	88.7
max	

Fig.: element concentration with min. and max. value



SPECTRO 4/22/2017 10:56:41 AM

Method: Al-20-D 4/22/2017 10:56:33 AM
Comment: HS-1S Element concentration
Sample Name: Heat No: HS1S Grade:
Invoice No: Invoice Date:

	Si	Fe	Cu	Mn	Mg	Cr	Ni	Zn
	%	%	%	%	%	%	%	%
< x > (1)	6.84	0.557	2.64	0.170	0.358	0.0152	0.0126	0.354

	Ti	Pb	Sn	Ca	Cd	Hg	Na	Sr
	%	%	%	%	%	%	%	%
< x > (1)	0.0242	0.0421	0.0094	0.0332	0.00087	> 0.0120	0.0041	< 0.00010

	Al
	%
< x > (1)	88.9

Fig.: element concentration addition calculation

Table: calcium %and density index come.

Sr.no.	Calcium %	Density index
1	0.0836	3~6
2	0.0606	2~5
3	0.0332	1~3
4	0.0217	1~2.5
5	0.0100	0~2.0
6	0.0040	0~1.5

III. PROJECT RESULTS AND DISCUSSIONS

After establishing the value of calcium with density index we can plot a graphical representation as following:

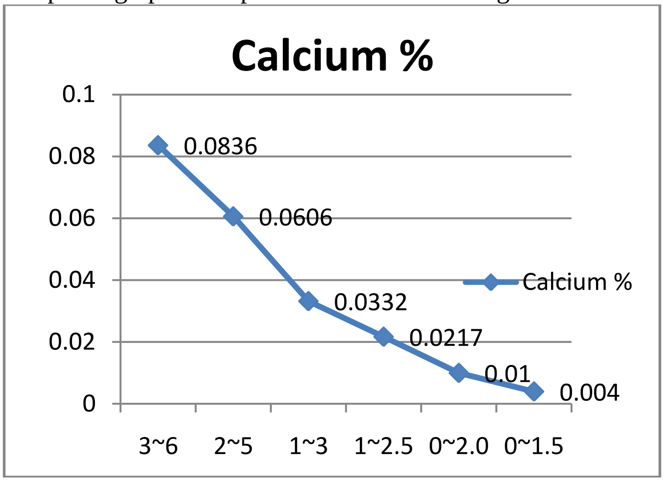


Fig: Density index & calcium %

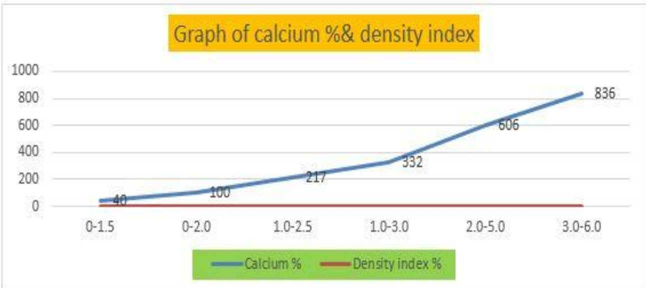


Fig: Graph of calcium % &density index up warding

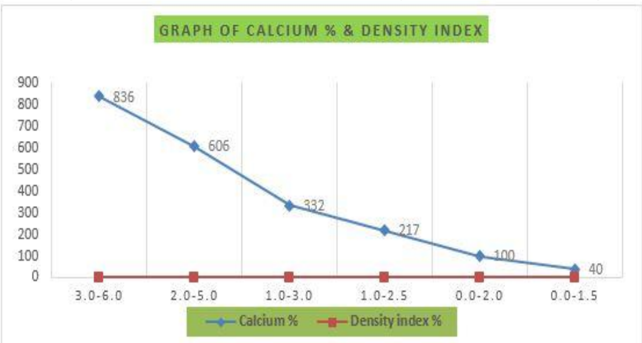


Fig: Graph of calcium % &density index down warding

IV. CONCLUSIONS

Based on the results obtained in this study, the following can be conclude;

1. When density index is less than 1% porosity defect eliminated completely
2. Calcium also found in the silicon with different -different range.
3. The aluminium molten metal composition in which calcium less than 100 % surface appearance good.
4. Higher calcium % near 700 not good for density index.
5. Tensile strength increase when density index less than 1%.
6. Influence of different alloy compositions on degassing efficiency.

Thus, it can be safely concluded that the output quality characteristic is greatly improved by the used of less than 100 % calcium in aluminium molten metal.
The project work is successfully completed.

It is clear from this study by every element in the aluminium molten metal composition having its impact upon the mechanical properties. From this study scope for future work in many field like

1. Automobile parts like cylinder head and other automobile parts.
2 In Aerospace manufacturing .
3. Construction (windows, doors, siding, building wire, sheathing, roofing, etc.).[
4. Transportation (automobiles, aircraft, trucks, railway, cars, marine vessels, bicycles, spacecraft, etc.) as sheet, tube, and castings.
5. Packaging (foil, frame of etc.).

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