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Behaviour of Lustrous Carbon Additives in Green Sand Casting

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ABSTRACT

The advent of High Volume, High Density & High-Pressure Moulding Lines has changed the logistics of Molding Techniques and selection of additives significantly. Having 4 main ingredients, Base Sand, Bentonite, Lustrous Carbon Additives & Water, the properties of the Sand Mold resulting from this simple mixture to deliver target casting quality is complexly variable. Sand Control is an "Art" as any foundry man will willingly emphasize. It is well accepted that no two-foundry sand systems are the same. Even a single foundry Unit or foundry group having two or more molding lines, along with separate Sand preparation lines, whether in the same campus or in different locations, sand preparation and sand parameters will normally differ in each sand loop The role of quality in additives has therefore become even more important than when one could "feel" the sand & make changes accordingly. Now, additives and ingredients have to be engineered precisely for the application with assured reproducibility in chemistry, grain fineness & other parameters.

KEYWORDS: *reproducibility, grain fineness, parameters*

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1. INRODUCTION

Green moulding sand process has a long history. A large production of castings, including the vast majority of those made by machine moulding, is cast in greensand moulds.

The process uses natural sand as the main ingredient for moulding for which any sand treatment equipment is not necessary. It is a popular moulding process for those foundries producing small and medium size castings and may not be able to lose its position due to economic considerations.

The advent of High Volume, High Density & High Pressure Moulding Lines has changed the logistics of Moulding Techniques and selection of additives significantly.

Having 4 main ingredients, Sand, Bentonite, Water & Additives, the properties of the Sand Mould resulting from this simple mixture to deliver target casting quality is complexly variable.

Modern machine moulding parameters demand increasing efficiency from the additives, many of which are natural resource based; having limitations for developing their inherent properties under the speed, force and load conditions of modern foundry installations.

This challenge to optimize a given natural resource escalates sand preparation and management from being an 'art' to being a 'science'.

Consequently, the importance of maintaining range-bound values of the prepared Sand in addition to the promotion of a 'reducing' atmosphere in the metal-moldinterface can minimize the occurrence of sand related defects.

1.1. Greensand Moulding System

A typical green moulding sand mixture/aggregate should consist of the following:

1. Base Sand (Commonly Silica Sand)
2. Clay (Bentonite/Montmorillonite)
3. Moisture
4. Additives (Lustrous Carbon Additives)

Sand

The sands are granular materials normally obtainable or artificially produced by the disintegration or crushing of rocks. Sand is an aggregate material essentially consisting of tiny, loose grains, minerals, or rocks which are no larger than 2 mm or smaller than 0.05 mm in diameter. Sand also denotes a class or several minerals – rather than just one mineral – such as silica or quartz. Zircon, olivine, chromite, and ground ceramic minerals, as well as silica are classified as sand when they are in this size range. Most green sand molds consist of silica sands bonded with a bentonite-water mixture. (The term green means that the mold, which istempered with water, is not dried or baked.) The composition, size, size distribution, purity, and shape of the sand are important to the success of the mold making operation

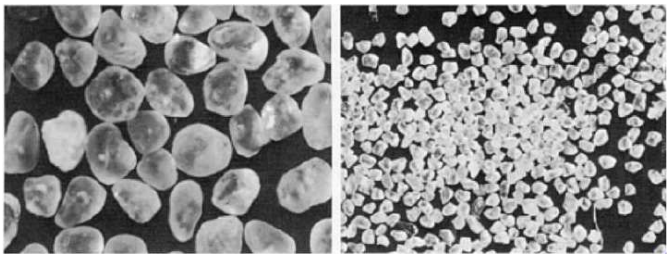


Fig 1: Two sizes of rounded sand grains

1.2. Composition

Foundry sands are composed almost entirely of silica (SiO2) in the form of quartz. Some impurities may be present, such as ilmenite (FeO-TiO2), magnetite (Fe3O4), or olivine, which is composed of magnesium and ferrous\ortho silicate [(Mg,Fe) SiO4]. Silica sand is used primarily because it is readily available and inexpensive. Quartz undergoes a series of crystallographic transitions as it is heated. The first, at 573 °C, is accompanied by expansion, which can cause moldspalling. Above 870 °C, quartz transforms to tridymite, and the sand may actually contract upon heating. At still highertemperatures (> 1470 °C), tridymite transforms to cristobalite.

1.3. Clay

In addition to sand, moulding sands may contain from 5-8 % clay as a binder. The word clay is applied to a particular group of minerals which vary from fireclay (kaolinite) to Western or Southern bentonite (montmorillonite) and a few special clays (halloysite and illite). They are residual or weathered products of various kinds of silicate rocks. Clays the general structure form of Powder in the approximate particle size range 100 to 75 micron in dimension.

1.4. Moisture

In moulding sand aggregate is as essential as the clay substance itself. The bonding strength of the mould to retain the shape of the casting is developed by the sand-clay-water system.

Thus, the purpose of the clay will not be served until the required amount of moisture/water added to it.2-5% of Water is added which furthermore activates the clay in the sand causing the Aggregate to develop Plasticity and strength.

2. LITERATURE REVIEW:-

MariuszHoltzer [1] introduced a paper on Selection Criteria of Lustrous Carbon Carriers in the Aspect of Properties of Green Sand System. Most of castings produced in the European Union are made with use of classic moulding sands, bentonite based sands containing lustrous carbon carrier. carbonaceous additive is still the most popular coal dust. A search for substitutes of coal dust with increased ability to form lustrous carbon is underway Foundries seek to reduce costs, produce good quality castings and maintain safe working conditions.

Izdebska-Szanda, Zb. StefaĔski , F. Pezarski , M. Szolc [2] displayed a paper on Effect of additives promoting the formation of lustrous carbon on the knocking out properties of foundry sands with new inorganic binders. The results of investigations regarding the effect of lustrous carbon carriers on the technological properties of foundry sands with inorganic binders were presented in a concise manner. The selected additives were introduced to moulding sands prepared with the new, modified, inorganic binders bonded by the chemical reaction or by blowing with gaseous CO2. In the research paper numorous studies has been done and experimentation has been performed to find out the results of investigations concerning the knocking out properties of sands made by adding different inorganic binders which makes it different by adding special additives to improve the knocking out properties of the sample sand while taking care of high level of mechanical properties necessary to produce moulds and cores of high quality.

BhagyashreeDesai [3] experimentaly studied to under seek the effect of various additives on the green sand molding properties as a particular combination of additives could yield desired sand properties. The input parameters (factors) selected were water and powder (Fly ash, Coconut shell and Tamarind) in three levels. Experiments were planned using design of experiments (DOE). On the basis of plans, experiments were conducted to understand the behavior of sand mould properties such as compression strength, shear strength, permeability number with various additives.

3. RESEARCH LOCATION, PERSPECTIVE & METHODOLOGY:-

3.1. Research Objective:

- To study the behaviour of lustrous carbon additive in green sand casting.
- Lab testing of the sample of lustrous carbon additive which is used in Industries.
- To estimate the potential of the sample quality of Rudransh Industries Pvt. Ltd.
- To present the evaluation and data obtained from Rudransh Industries Pvt. Ltd

Rudransh Industries Pvt Ltd is one of the renowned Manufacturers & Exporters of Mould Additives LikeBentonite powder, Lustrous Carbon Additives/ Coaldust, Premix Bentonite, Graphite Powder & Insulating Sleeves used in Foundries/Green Sand Castings. Having an Experience of More than 30 years, Rudransh Industries Pvt Ltd. Produces and Exports high quality Material with its Highly specialized technology. Rudransh Industries Pvt Ltd has an Experienced production team committed to produce specialized Carbon Materials as per Customer's NeedRudransh Industries Pvt Ltd is located in Anjar, Kutch(Gujrat). Location of the setup is very much favourable for the raw material extraction.

4. RESULTS AND OUTCOME

Preparation of Sample: It is expected that methods of sampling prescribed in IS: 436 (Part IJScction1)-196'lt and IS: 436 (Part II)-1965 would have been followed in the preparation of samples sent to the laboratory. Besides, the laboratory samples to be used for the analysis of coal. The samples prepared in accordance with IS: 436 (Part I/Sec 1) 1964 and IS: 436 (Part 2)-1965§ shall be received in sealed containers and shall consist of about 300 g of coal or coke ground to pass. 212-micron IS sieve. Where air-drying has been adopted in the preparation of the samples, the percentage loss of moisture in this operation shall be recorded on the label together with the relevant Indian Standard method of sampling used.

Determination of Moisture

Forms and Conditions of Moisture - The moisture present in the laboratory sample of coal and coke is of importance both in proxirnate analysis and in calculating other analysis results. Moisture and free water may be defined as follows:

A. Total moisture - The coal which has been exposed to contact with water in the seam or in a washery, or coal and coke wetted by rain, may carry free or visible water. This water plus the moisture within the material, is referred to as total moisture,

B. Moisture in coal equilibrated at 60 percent relative humidity and 40°CThe moisture content of air-dried coal varies and depends upon the temperature and relative humidity of the air to which it is exposed. As such it is necessary to determine moisture content of different samples of coal under standard conditions. For this purpose, the coal is ground to pass 212-micron IS sieve and equilibrated in an atmosphere of 60 percent relative humidity and 40·'0. The moisture determined under these conditions shall be taken as reference moisture for all purposes.

C. Moisture in coal equilibrated at 96 percent relative humidity and 40°0- This is also termed as 'Near Saturation Moisture' or 'Bed Moisture'. It is exclusive of free or visible water and is determined after equilibrating coal in an atmosphere of 96 percent relative humidity and 40°C. This is a measure of the moisture holding capacity of a coal.

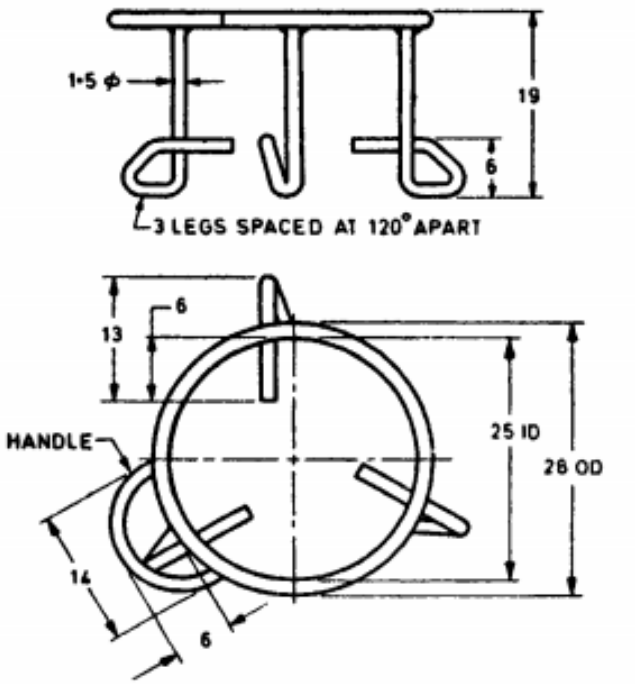
D. Free water or visible water - Free water or visible water is that quantity of water which is physically adhering to coal. In essence, this is that quantity of water which is in excess of the moisture holding capacity of a coal.

E. Moisture in air-dried laboratory analysis sample if coal and coke - It is the moisture in coal which has been air-dried under the laboratory atmospheric condition prior to analysis and is determined as a part of proximate analysis and also whenever portions of sample arc weighed later for other analysis and tests. If all the portions for analysis are weighed under approximately the same conditions of humidity, one determination of moisture will suffice, but a check is desirable with high moisture coals.

Stand-

The stand on which the crucible is placed in the muffle furnace shall be such that the appropriate rate of heating can be achieved. For example it may consist of:

A. for single determinations- a ring of heat-resistant steel wire as shown in with two asbestos discs, 25 mm diameter and 1 mm thick, resting on the inner projection of its legs.



A Suitable for Making One Determination at a Time

5. LAB TESTING OF THE LUSTROUS CARBON ADDITIVE SAMPLE

Sampling: Sample of the Lustrous Carbon Additive has been made as per the testing protocol written in IS 1350-1 (1984) which has been elaborated in chapter 5

Determination of Moisture: Drying in Air (two stage)- Testing has been performed on the parameter of Testing Protocol. Following observation has been recorded:

Total Moisture content of original sample = X + r (1 –X/100)

X= 0.08 gm

r= 4.42 gm

Total Moisture content of original sample ($W_{2)}$ = 4.4964 gm

Calculation of Results:

Moisture Percent- $(W_1-W_2/W_1)*100$

= (5-4.4964)/5*100

= **10.07%**

Where W_1 = Sample of 5 gm

Determination of Volatile Matter:

Percent volatile matter, $V= 100((M_2-M_3)/(M_2-M_1)) - M_0$

Where

Mo = percentage of moisture in the sample on air dried basis = 10.07

M_1 =mass in g of empty crucible and lid= 18 gm

M_2. = mass in g of crucible plus lid and sample before heating; and = 23 gm

M_3 = mass in g of crucible plus lid and sample after heating = 19.839 gm

Percent volatile matter, ***V*= 53.15 %**

Determination of Ash:

Calculatio

Ash, percent by mass = 100 X $(M_3-M_4)/(M_2-M_1)$

Where

M_1 == mass in g of dish = 50gm

M_2 = mass in g of dish and sample = 55gm

M_3 = mass in g of dish and ash = 54.79

M_4 = mass in g of dish after brushing out the ash and on reweighing = 54.71 gm

Ash, percent by mass = **5.6 %**

Reporting of Results

7.4.1 On Air Dried Basis

7.4.1.1 The following symbols shall be used without any suffix:

Mo = percentage of moisture in the sample = **10.07 %**

A = percentage of ash in the sample = **5.6 %**

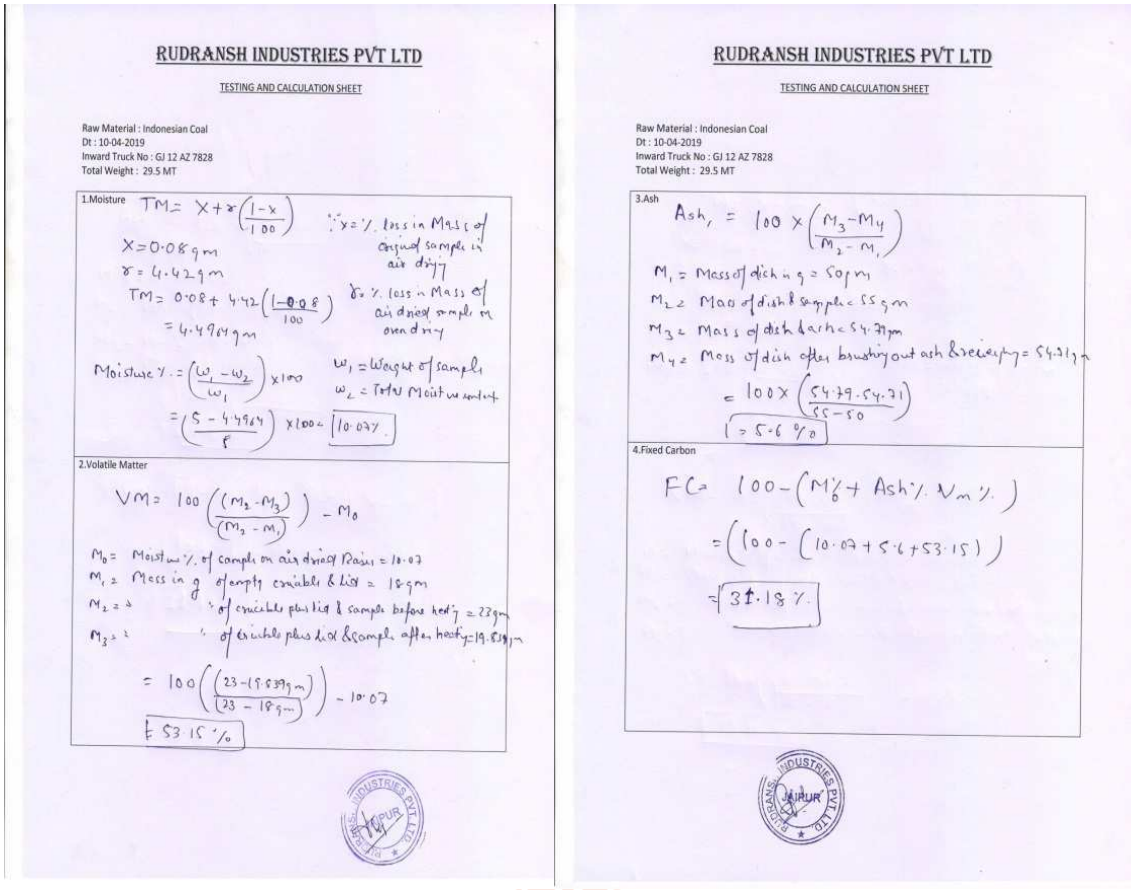
V =: percentage of volatile matter in the sample = **53.15 %**

F =: percentage of fixed carbon in the sample,

7.4.1.2 Fixed carbon is arrived at after deducting from 100 the sum of moisture, ash and volatile matter contents expressed as percent, that is.

Fixed carbon, *F* - 100 - (Mo + A + *V)* or Fixed carbon Percent = (100- (10.07 + 5.6 + 53.15))

= **31.18 %** (Residue after volatile matter test minus ash)



Conclusion:-Raw coal contains some moisture. To remove this moisture, the coal is dried up with the help of Sun heating. Sun drying is done by dispersing the coal on open field. 3-4 Days of drying will suffice. Once sun drying is done. It is again dried in Hot air Furnace to Remove extra moisture. It is done in the batch of 2000 KG once drying is completed, the dried raw coal is then mixed with 1-2% Saw dust. For example: A batch of 100 KG LCA will contain 98 kg of raw coal and 2 kg of Saw dust. After mixing, the resultant mixture is then grinding in the grinding mill. The final grinding powder is then packed in 25 Kg HDPE laminated paper bags The Final product must be stored in Cool Atmospheric / Ventillated Conditions. There should be a spacing of 0.2-03 Metre between each stack. Otherwise there may be risk of Fire.

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