Utilisation of Waste Foundry Sand by Converting It to an Integrant for Grinding Application

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Abstract **: Conservation of natural resources and preservation of environment is the essence of any development. Foundries successfully recycle and reuse the sand many times in a foundry unit. When the sand can no longer be reused in the foundry, then its become a waste product. Like many waste products, foundry sand has beneficial applications in other fields..In an effort to use the WFS in large volume, research has being carried out for its possible large scale utilization. In this project we have taken some idea to implement Waste foundry sand to use as a integrant(SiC) in the grinding applications.**

INTRODUCTION:

Foundry sand consists primarily of clean, uniformly sized, high-quality silica sand or lake sand that is bonded to form molds for ferrous (iron and steel) and nonferrous (copper, aluminum, brass) metal castings..Metal foundries use large amounts of sand as part of the metal casting process. Spent foundry sand consists primarily of silica sand, coated with a thin film of burnt carbon, residual binder (bentonite, sea coal, resins) and dust.

OBJECTIVE: Our idea is to utilize the useful minerals which are available in foundry sand which will not be used further in casting industries and also in an account of the safe disposal of foundry sand. The main content which was found in foundry sand is silica. Silica has a enourmous applications and it has been effectively used. Our aim is to use the silica in form of silicon carbide in grinding application

WASTE FOUNDRY SAND USAGE METHODS:

1. It can be used where the sand is bounded (i.e. contained) and stabilized in a manufactured product.
2. It can be used where the sand is usually contained but not stabilized in geotechnical applications such as road bases, embankments, construction fill and landfill.
3. It can be used where the sand is not usually contained or stabilized such as the use of sands in agricultural products including soil amendments, compost, manufactured soil and top dressing.

Above these we are going to implement the 1st method of usage.

AS AN ABRASIVE:

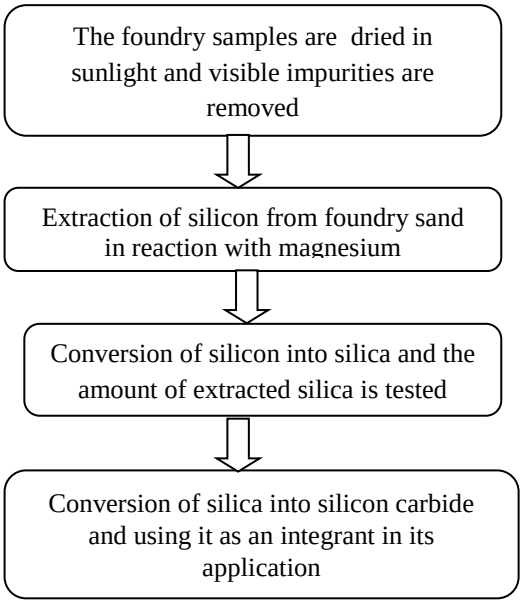
A grinding wheel is a wheel composed of an abrasive compound and used for various grinding and abrasives operations such wheels are used in grinding. Silicon carbide and aluminium oxide are the two major abrasives used in the manufacturing of grinding wheels. We have an idea of preparing silicon carbide abrasive from the waste foundry sand.

LITERATURE REVIEWS:

The Author[1] has silica have abrasives properties which can be obtained from the foundry sand itself. The Author[2] have elucidates that there is a possibility of separating the silicon from the sand and it can extracted and estimated by his method with help of magnesium powder. The Author [3] , they have used the waste foundry sand and granulated blast furnace slag in manufacturing of bricks which in they can be use in the proportional ratio. In many other cases we can able to use the WST in a proportional mixture with the natural one. The Author[4], They also states the method of extracting silicon from the foundry sand but they have used magnesium ribbon instead of magnesium powder which also reduces the cost of the extraction process. the Author[5] , They have explained about the formation of silicon carbide from the silicon and carbon particles,this experiment will helps us in the crystallization of silicon carbide. the Author[6] , we can understand about the characteristic of foundry sand after the casting process. They also insist about the partial replacement in their application.

METHODOLOGY:

The below methodology is proposed based on the referring the journals. This methodology is unique on converting the foundry sand into silicon carbide



EXTRACTION OF SILICA FROM FOUNDRY SAND:

Metallurgical grade silicon can be obtained from sand (SiO2) when it has burn until the oxygen is removed from Sand. For this process we need magnesium. Magnesium ribbon cut into small size with scissor and the ratios followed between the foundry sand and magnesium ribbon are 1:2 (2grams:4grams)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Both the samples are collected in a crucible and placed in electric muffle furnace until the magnesium burns and react with the sand. Normalizing of sample was done by cooling them in presence of air after heat treatment. During heat treatment

$$SiO_2\ (s) + 4Mg\ (s) \longrightarrow 2MgO\ (s) + Mg_2Si\ (s) + \text{Energy}$$

When Silica was heated in presence of Mg ribbons the resultant product with a combination of MgO and MgSi is formed.

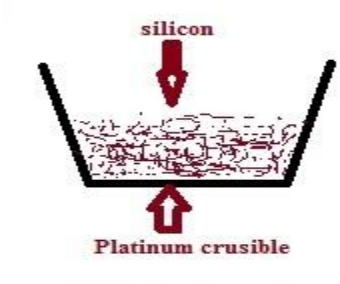

This product is treated with Concentrated HCl solution. And acid solution is taken on the basis of, for 1 gram Mg 50ml Hcl. After adding HCl, the MgO and MgSi converts into $MgCl_2$ and it is AN exothermic reaction. Reactions occurred in solution are following

$$MgO\ (s) + 2HCl\ (l) \rightarrow MgCl_2\ (l) + H_2O\ (l)$$
$$Mg_2Si\ (s) + 4HCl\ (l) \rightarrow Si\ (s) \downarrow + 2MgCl_2(l) + 2H_2\ (g)$$


Finally the silicon particles are deposited below and the magnesium chloride are in the form of liquid and the hydrogen gas is evaporated. The liquid are poured down and the deposited silicon is dried and weighted By this experiment we can separate the silicon from the foundry sand.



CONVERSION OF SILICON INTO SILICA:

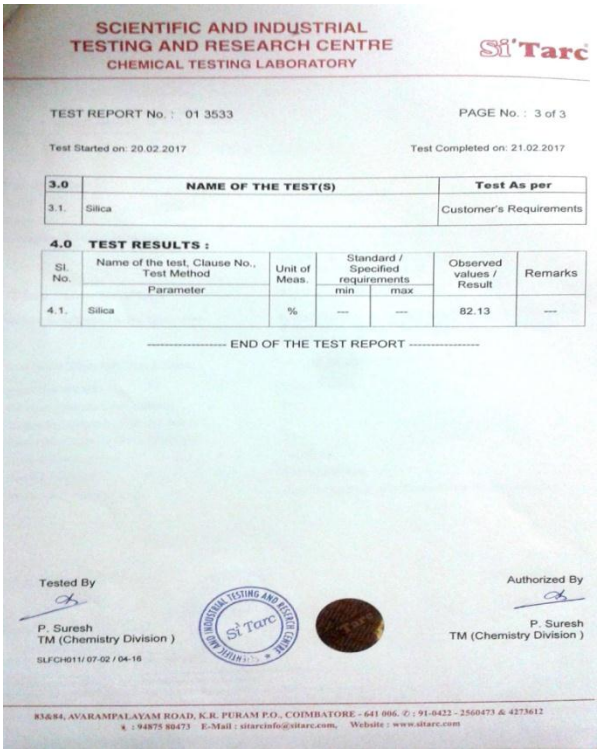


The setup is kept in the furnace at 1100 °c for 30 mins .After 30 min pure silica is obtained

The silicon product was placed in a platinum crucible weighed. The setup is put in a furnace at 1100 ^{0}c for 30 minutes.After which it was removed allowed to cool in a desiccators and weighed again. Pure silica is obtained in this process.




The sample is tested for presence of silica. The sample is tested at si'taarc



SCIENTIFIC AND INDUSTRIAL TESTING AND RESEARCH CENTRE
CHEMICAL TESTING LABORATORY
Si'Tarc

TEST REPORT No. : 01 3533 PAGE No. : 3 of 3

Test Started on: 20.02.2017 Test Completed on: 21.02.2017

3.0	NAME OF THE TEST(S)	Test As per
3.1.	Silica	Customer's Requirements

4.0 TEST RESULTS :

Sl. No.	Name of the test, Clause No., Test Method / Parameter	Unit of Meas.	Standard / Specified requirements min	max	Observed values / Result	Remarks
4.1.	Silica	%	---	---	82.13	---

---------- END OF THE TEST REPORT ----------

Tested By
P. Suresh
TM (Chemistry Division)
SLFCH011/ 07-02 / 04-16

Authorized By
P. Suresh
TM (Chemistry Division)

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FORMATION OF SILICA CARBIDE :

From the above obtained silica, we have tested and we obtained the result that it has 82% of silica which is sufficient to react with coke to obtained silicon carbide. The Extracted silica are reacted with carbon particles as per the Acheson process Silicon carbide is conventionally made by reacting silica particles with carbon particles at 1800 -2000 ^{0}C. As a final product we get silicon carbide particles.

The chemical reaction involved in this process is

$$SiO_2 + 3C \rightarrow SiC + 2CO$$

The silicon carbide obtained can be used in various applications based on the property it has been achieved.

CONCLUSION:

Various grades of silicon carbide is available in the market which are obtained from natural mines. We are getting silicon carbide at a rate of Rs.7/gram (appox.). Preparing the silicon carbide in above terminology we can utilizes the waste foundry sand. This methodology is also a good method for disposal of foundry sand rather than storing it as dump in the land. Since silicon carbide is also a abrasive material it can used in various grinding applications such as grinding wheel, flap disc, emery sheets etc,. This may a replacement of silicon carbide getting from naturals mines and can be used as an integrant in grinding applications.

REFERENCE:

[1] Mohammad Mansour (2015) "Develop A Strategic Forecast of Silica Sand Based on Supply Chain Decomposition" - International Journal of Engineering (IJE), Volume (9) : Issue(1) : 2015

[2] Idrisa Wazamtu Email et al., (2013) "Extraction And Quantification of Silicon From Silica Sand Obtained From Zauma River, Zamfara State, Nigeria" - European Scientific Journal May 2013 edition vol.9, No.15

[3] Sanmathi B. M., Amar R (2015) "An Experimental Investigation on Utilization of Waste Foundry Sand and Granulated Blast Furnace Slag as Partial Replacement to Sand in Fly Ash Bricks" - International Journal of Engineering and Innovative Technology (IJEIT) Volume 4, Issue 8, February 2015

[4] Md Vazeed, J Akash, M Anusha, Ajay Kumar V (2015) "Quantitative and Qualitative Analysis of Silicon extracted from Godavari river sand , Kandakurthi, Telangana, India" - International Journal of Engineering Research & Technology (IJERT) Vol. 4 Issue 11, November-2015

[5] A. O. Odior and F. A. Oyawale (2011) "Formulation of Silicon Carbide Abrasives from Locally Sourced Raw Materials in Nigeria" -Proceedings of the World Congress on Engineering 2011 Vol I WCE 2011, July 6 - 8, 2011, London, U.K.

[6] Dushyant R. Bhimani et al., (2013) "A Study On Foundry Sand: Opportunities For Sustainable And Economical Concrete" - Global Research Analysis (GRA) Volume : 2 Issue : 1 Jan 2013