Proceedings of the 72nd World Foundry Congress
21-25th May 2016, Nagoya, Japan

Post casting residual strength development of new generation inorganic binders using different South African silica sands.

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Abstract

The paper investigates the performance of two local silica sands using a new generation modified sodium silicate binder. The binder is a water glass based system. It is used as a one-component liquid binder in the range between 1.5 and 3.0 mass %. The hardening can be realized with CO_2 gassing, liquid ester hardeners or with heat and heated air. Three curing methods of the sodium silicate were considered which CO2, ester and heat are. The methodology followed consisted of sand characterization and residual strength measurement of strength specimen exposed to heat after curing. The test results revealed the profound influence of the sand properties on the residual strength of the sand. Because of the difference of properties of the two sands, they behave differently with the same sodium silicate binder.

Keywords: *Inorganic binder, residual strength, silica sands*

1. Introduction

The more understanding of the importance of environmental protection, the application of green products for foundry becomes one of the most urgent tasks [1]. Inorganic binders became unpopular in the foundry industry because of their poor shake out properties due to high residual strengths after casting. [2]. Despite sodium silicates' many favourable characteristics unmodified sodium silicate binders have one key problem which is the difficulty in shake out or inability to break down after metal solidification [3].Collapsibility is of particular importance in terms of recyclability of sodium silicate used sands. Poor collapsibility is due to high residual strength of used sand after the casting process. The Residual strength of sodium silicate used sand is a function of temperature reached by the sand during the casting process. The highest strength is developed in areas around the casting where the sand has been heated between 800^0C and 1000^0C. Lower strengths are developed in the regions where the sand reached temperature between 400^0C and 600^0C [4].

Despite the knowledge accumulated with regards to sodium silicate moulding technology, it is not always possible to predict how a new commercial binder will perform with untested refractory sands. This paper tackles this questions in the case of a single component new generation inorganic binder from Germany using South African local silica sands for foundry applications.

2. Experimental Procedure

The experiments related to this investigation were conducted according to figure 1 below:

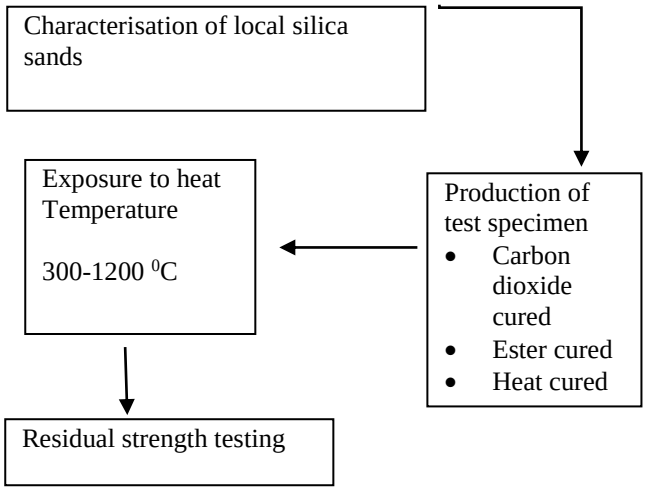

Figure 1 Experimental procedure

3. Residual strength results

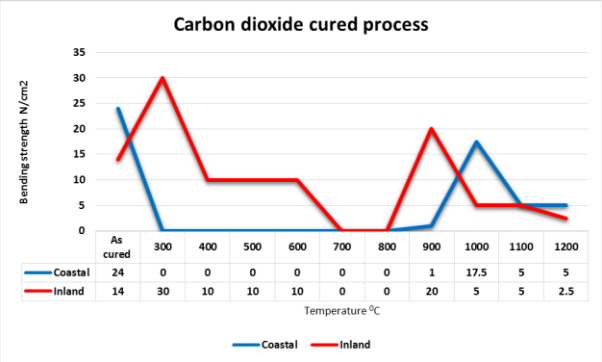

Figure 2: Residual strength of CO_2 cured sand at different temperatures of exposure to heat.

Figure 2 shows the residual strength results under the gas curing process. It can be seen that when exposed to heat, the inland and coastal sands differ in residual strength. For some of the heat exposure temperatures.

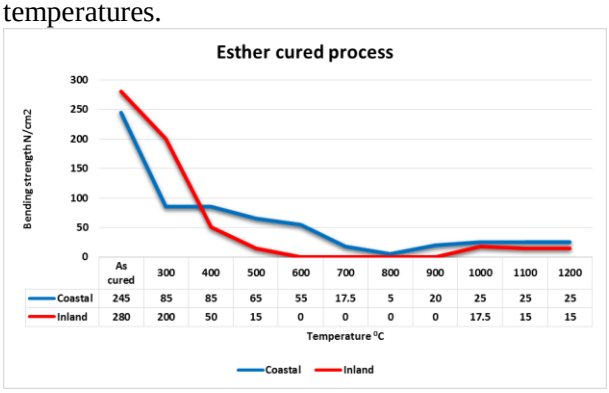

Figure 3: Residual strength of ester cured sand at different temperatures of exposure to heat.

Figure 3 shows the residual strength results under the ester curing process. It can be seen that the inland and coastal sands differ in residual strength for all of the heat exposure temperatures.

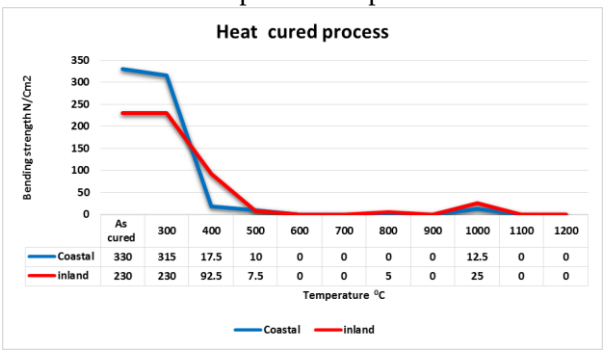

Figure 4: Residual strength of heat cured sand at different temperatures of exposure to heat.

Figure 4 shows the residual strength results under the heat curing process. It can be seen that when exposed to heat, the inland and coastal sands differ in residual strength. For some of the heat exposure temperatures.

4. Conclusion

The study investigated the effects of sand properties and the different curing methods on the residual strength of sodium silicate sands. It was found that;

- Each sand has its own characteristic behaviour with regards to the rate of drop in residual strength based on its properties.
  - The behaviour of the sands after the last peak or glassy phase was consistent with the type of curing process.
  - The residual strength after the glassy phase/last peak is ranked in the following order from highest to lowest
    - Ester cured
    - Carbon dioxide cured
    - Heat cured.

Acknowledgements

I would like to acknowledge the Metal Casting Technology Station staff for their assistance in the laboratory work

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