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Dynamic Testing of Green Sand

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Foundry engineers have long known that certain AFS standard green sand properties tests provide limited information for green sand control. This limitation is especially apparent when strict casting dimensional control and a superior casting surface is required. Dynamic green sand tests such as: thermal erosion test (TET), the wet tensile strength (WTS), the modified cone jolt toughness test (MCJT) and the friability test were able to differentiate among various compactability levels (moisture content) and clay levels. This paper focused on sodium Bentonite, calcium Bentonite and various blends. The dynamic tests provide more relevant data about these green sand systems. The results obtained in this study are very encouraging, and presents the opportunity to develop new green sand control tools using data from both room and elevated temperature tests in order to produce high quality castings.

Keywords: *thermal erosion test, wet tensile strength, modified cone jolt toughness, friability*

1. Introduction

The majority of casting defects in sand casting facilities are sand related, but many metal casters fail to recognize that molding sand quality is as important as metal quality [1]. Many foundries incorporate different bond formulations to produce the green properties they feel they need to produce acceptable castings. The green sand molding process brings with it some potential weaknesses for casting parts of various shapes, sizes, and alloys. Measurement and control of green sand properties is critical to the green sand foundry's success. The typical properties that are monitored are green compression strength, compactability, moisture, methylene blue clay percentage and wet tensile strength (WTS).

Casting quality is directly related to mold quality and mold quality is directly related to sand control. To produce world-class castings competitively and to meet the ever-increasing demands for higher quality and dimensional reproducibility, sand control is essential [2,3]. A good understanding of essential process requirements is needed to deal with day-to-day problems. Over the years, several noted papers on "green sand system control" have been published; however the common theme for success in green sand control is sticking to the basics [2-5].

Foundries carry out green sand testing as an essential part of process/quality control. Foundries depend on the AFS sand tests to help manage their new sands, green sand systems, chemically bonded cores and molds, sand additives and reclaimed sands. The testing procedures are defined by the AFS [6].

In order to produce high quality castings, the purpose of this paper is to determine whether a foundry can monitor changes in sand properties caused by small changes in clay and moisture levels when using non-standard green sand testing such as a thermal erosion test (TET) and a modified cone jolt toughness test (MCJT)

2. Dynamic Testing

Fig. 1 shows a picture of the thermal erosion test TET as one of dynamic test. This machine is developed at Western Michigan University (WMU) and allows dynamic testing of a modified two by two specimen against a rotating hot surface where eroded sands are measured in real time.

The modified cone jolt toughness test measures the sand's bulk brittleness, and is related to difficulty in pulling deep pockets in a pattern. The jolt/displacement curve affords ultimate strength, toughness, stiffness and plastic green sand property data. The modified cone jolt toughness test is directly related to compactability and measures the green sand system's ability to absorb energy [7].

When thermal erosion data is examined as compactability increases for the same level of clay in the green sand system there is generally a decrease in the percent green sand loss at room temperature (Fig. 2). However, there are more losses in Ca Bentonite green sand system for every compactability level tested but especially at the lower compactability levels.

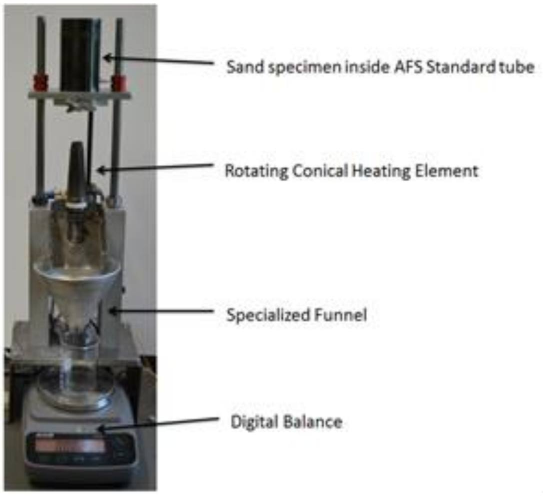

Fig. 1 TET and Data Acquisition System.

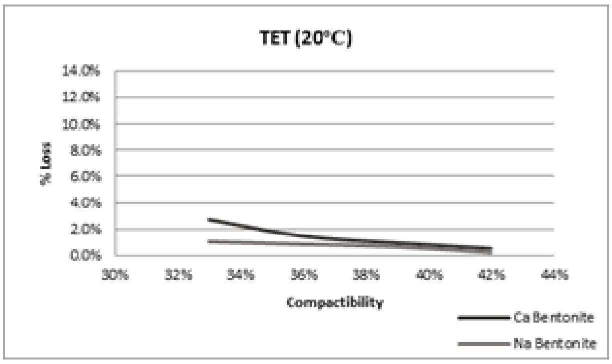

Fig. 2 Percent loss (abrasion) at room temperature as percent compactability is increased.

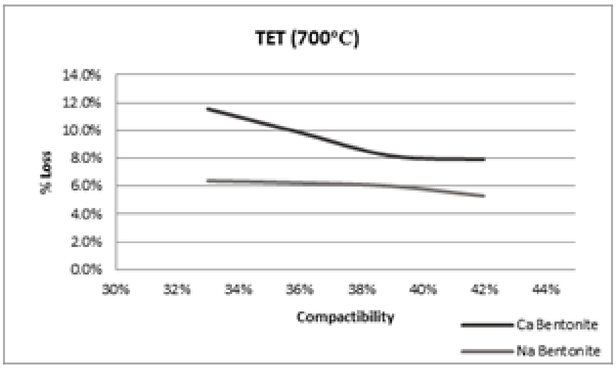

Fig. 3 Percent loss (abrasion) at elevated temperature of Na and Ca Bentonite Green Sand Systems as percent compactability is increased.

When Na and Ca Bentonite green sand systems were tested at an elevated temperature the same general trend was seen as tested at room temperature. As compactability was increased, there was less loss in both systems. However, the major difference is that a greater percent loss occurs at all the compactability levels but the losses are less drastic with Na Bentonite green sand system (Fig. 3).

3. Conclusions

The dynamic green sand tests such as: thermal erosion test (TET), the wet tensile strength (WTS), the modified cone jolt toughness test (MCJT) and the friability test were able to differentiate among various compactability levels (moisture content). Friability and TET (both ambient and elevated temperature) indicate that green sand system with 100% Na Bentonite had superior abrasion resistance. The results are very useful to define a good green sand to produce a high quality casting.

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