Chemically bonded and green sand cores and molds (coated or uncoated) are a key part of metal casting technology. Their behavior, when contacting molten metal during casting, is of crucial importance for creating a quality casting with exact tolerances.

Directional heating of a shaped sand composite during casting generates anisotropic thermal gradients, while pouring molten metal increases the pressure on the mold and core. The heat transfer and increased pressure causes thermo-chemical reactions within the sand composite that result in pyrolysis and increased friability, mold dimensional changes, distortions, veining and erosion. Refractory coatings can be used to improve mold and core surface finish, reduce thermal expansion defects such as veining, and un-bonded sand defects such as erosion, but are costly and cannot compensate completely for instabilities in the sand composite.

Consistent molds and cores providing high tolerances requires testing of sand composite samples under conditions that simulate the real-world stresses of the metal casting process.

Technology Description

Dr. Ramrattan has developed an advanced Thermal Distortion Tester (TDT) that provides a more exact and comprehensive profile of mold performance during casting, through accurate testing of multiple sand composite parameters, several of which are only available with this advanced TDT device. The TDT utilizes a standard (5 cm) diameter, disc-shaped specimen and measures the thermo-mechanical behavior of sand composites (coated and uncoated) by contacting the specimen to a thermocouple controlled, hot surface that simulates the molten metal. Specimen expansion; radially and longitudinally, and distortion are continuously measured, along with longitudinal thermal gradient changes (determines the heat dissipation properties of different composites and coatings). Samples of different thicknesses can be tested (modeling different mold thicknesses). Constant or variable pressure (simulates head pressure changes during filling) or temperature (simulates heating and heat dissipation) can be applied to the specimen. A computer system controls and monitors test parameters, collects data, and plots graphs of pressure, temperature and/or time versus other measured parameters.

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Potential Benefits

- Uses standard diameter samples with variable thicknesses
- Constant or variable temperature and/or pressure applied during testing
- Continuous measurement of multiple sample parameters during test period
- Computer control of all test parameters, and data collection and output