

## ABSTRACT

Increasing demand for moulding sand in metal casting industries, depletion of the high quality sand sources, as well as the increasingly strict environmental regulations and pollution control regulations of the present day, have necessitated research and development in the area of reclamation and reusability of used CO<sub>2</sub>-Sodium Silicate bonded sand which is generally thrown out as waste. Chapter one introduces us to the need for reclamation and reuse of foundry sands.

Chapter two deals with the literature survey on reclamation and in particular, reclamation of CO<sub>2</sub>-Sodium Silicate bonded sands. For reclamation of foundry sands, which use a non-regenerative inorganic binder like sodium silicate, the reclamation processes have not yet been fully developed. The literature review reveals the fact that even though CO<sub>2</sub>-Sodium Silicate process has been in use for the last thirty to forty years, important developments in reclamation are still being made in the field of CO<sub>2</sub> sand reclamation. Because of the nature of bonding, thermal reclamation is not possible for the CO<sub>2</sub>-Sodium Silicate bonded sands. Very little information is available on chemical reclamation, mechanical reclamation as well as combination of these processes. Also the reuse of reclaimed CO<sub>2</sub>-Sodium Silicate sand in green moulding has not been reported.

Chapter three deals with the scope of the present investigation. Used CO<sub>2</sub> sand has been subjected to pneumatic reclamation, mechanical reclamation in the horizontal centrifugal scrubber, wet reclamation, chemical reclamation, and combination of these reclamation processes. Assessing the properties of reclaimed sand, comparison with properties of new sand and used sand, as well as the investigation of the usability of

reclaimed sand in CO<sub>2</sub> -Moulding and in green sand moulding were the objectives of this study.

Chapter four deals with the detailed experimental investigations carried out to fulfil the stated objectives. Fabrication of pneumatic scrubber and horizontal centrifugal scrubber was carried out. The used sand was reclaimed by i) Pneumatic Scrubber, ii) Horizontal centrifugal Scrubber, iii) Wet reclamation, iv) Chemical reclamation and v) Combination of HCS+Wet method, HCS+Chemical method, and Chemical+Wet method. The used sand (before reclamation), reclaimed sands (obtained by the various techniques), as well as the new sand were individually tested for AFS number, loss on ignition, Na<sub>2</sub>O content, acid demand value, pH, base permeability and surface appearance (by scanning electron microscope) and other tests. To check the performance of the reclaimed sand, CO<sub>2</sub>-Sodium Silicate moulds were prepared using mixtures of reclaimed sand, used sand and new sand. Green sand moulds were also prepared with system sand by substituting reclaimed sand in place of new sand. All the moulds were prepared as per SFSA (Steel foundry society of America) standard block, step cone casting and penetration test casting. Grey cast iron and steel were poured in the CO<sub>2</sub> moulds. In the green moulds grey cast iron alone was poured. The various sand mixtures were also tested in detail for the various properties. The surface roughness value (Ra and RMS) of the SFSA were measured. Economic viability of introducing sand reclamation was also studied in detail, using a "C" program and costs were compared.

In chapter five, the results and discussions of various experimental trials carried out are presented and discussed in detail. The efficiency of reclamation process, properties of sands in the bonded and unbonded condition, test casting surface details and discussions based on the results are presented.

Chapter six deals with the conclusions drawn and gives the suggestions for further research. The major conclusions of this research are :

- 1.The CO<sub>2</sub>-sodium silicate bonded sand can be successfully reclaimed by mechanical methods (pneumatic scrubber and horizontal scrubber) , wet method, chemical method and combined method.
- 2.Total residual bond [Na<sub>2</sub>O] conversion / removal is possible in the reclamation process.
- 3.The reclaimed sand can successfully substitute new sand in CO<sub>2</sub> moulding and green sand moulding.
- 4.The reclaimed sand properties like AFS No,loss on ignition,permeability, compactability, and strength are almost equal to that of the new sand.
- 5.The experimental castings produced with reclaimed sand were as good as the castings produced from new sand.
6. Combined reclamation processes i.e. reclamation by more than one method have been found to be more effective instead of a single reclamation.
7. The cost of reclaimed sand is 25-60% cheaper (based on the type of reclamation )when compared to new sand . Re-reclamation and reuse up to about 15 cycles is possible and the number of cycles is dependant on the type of reclamation.

The results of the work reported in this thesis will be of immense value to the foundry personnel involved in the reclamation of foundry sands.The studies will provide them the confidence and knowledge to reclaim and reuse CO<sub>2</sub> -Sodium Silicate bonded sand and it will solve the acute problem of disposal of used sand and the conservation of scarce new sand which is rapidly getting depleted.