ABSTRACT

Since the foundry industry in present days shift from traditional binders to synthetic binders, the reclamation process becomes more useful in reuse of sands for reducing foundry costs and increasing profitability. Among the various moulding processes, CO$_2$/sodium silicate sand moulding is used by a large number of foundries because of its intrinsic advantages which are enumerated in this chapter. Therefore this process is chosen for the purpose of investigating a novel reclamation process. In chapter 1, Introduction, the necessity and value of reclamation process is explained. The need for reclamation is felt when

(i) The cost of new sand, mixtures and ingredients is high, and
(ii) The expense incurred in disposal of used sand is huge.

Chapter 2 deals with increasing awareness and the development of the various reclamation processes over past few decades. The different reclamation processes namely: wet reclamation, dry, pneumatic and thermal reclamations are dealt in this chapter of literature survey.

Chapter 2 also explains about the sand characteristics and the relationship of sand characteristics with strength and other properties of the mould. The various reclamation processes are described giving importance to CO$_2$ / silicate sand reclamation. The different sand tests like moisture tests, permeability tests, etc. are explained. The behaviour of silica, including changes on structures on heating, as well as expansion and spalling tendencies are detailed. Technological update is discussed
with respect to CO₂ / silicate moulding, including the effect of external and internal variables on the sodium silicate process.

The process is discussed in detail and the various reclamation processes for CO₂ sand are described. As the new process developed in this work incorporates fluidized bed, the phenomenon of fluidization and the behaviour of fluidized beds are discussed. Advantages of fluidized beds and industrial applications of fluidized beds are also dealt with. Also the construction of a scrubber and its advantages are described, as this is part of the reclamation process developed in this work.

In chapter 3, the scope of the investigation is stated. The basic requirements which the reclamation process is expected to meet are detailed namely (i) quality of the sand to be comparable similar to that new sand, (ii) pollution free atmosphere in the reclamation environment and (iii) economical viability of the process.

The chapter 4 describes the operation and fabrication of reclamation unit for reclaiming CO₂ sand. The incorporation of the fluidizer and scrubber in the reclamation unit is a major innovation in this work. The variation of different parameters to achieve the optimal performance is also described.

In chapter 5, the results obtained by the detailed investigations are documented. The various sand properties like pH value, AFS number, ADV, Na₂O content, total clay content, permeability, water absorption, L.O.I. etc. of reclaimed, used and new sands are compared. Test castings are produced using reclaimed, used and new sand.
Their qualities are compared. Cost calculation using visual basic software and ‘C’ language is incorporated. Computational Fluid Dynamics (CFD) analysis is also carried out for fluidized bed as well as scrubber pertaining to the process for supporting the choice of optimum values for the parameters.

Conclusions of the thesis are listed in Chapter 6. Here it is clearly shown that this thermo-pneumatic reclamation process is quite effective to yield good quality reclaimed sand thereby solving the problems of availability of fresh sand, disposal of used sand, etc. Chapter 6 also provides minor suggestions regarding future work like safety features, prevention of health hazards and sustainable waste management.

The result of this work is of utmost importance to value the foundry industry, especially those foundries that are in the field of reclamation. The data acquired here is a boon to the reclamation industries. The conservation of sand could trigger an absolutely economic spurt in those industries where this CO₂ / silicate reclamation process is adopted.