

Movable Type KR (Hot Metal Desulfurization Equipment)

1 Introduction

Approximately 20 of the Kanbara Reactors (KRs), developed by Nippon Steel Engineering in 1965, have been supplied to the steelmaking industries of Japan and overseas. In addition, we have commercialized an efficient movable type KR which features high productivity and high desulfurization efficiency. Recent achievement within the movable type KR; two units are already under stable operation, and another is currently under construction in India. India is a market that is experiencing rapid growth in demand for high-grade steels, and there is a growing interest in India to the KR process due to their excellent desulfurization performance and competitive operational cost.

2 Characteristics of KR Process

KR has a rotating impeller made of refractory material that is inserted into the hot metal for desulfurization, through the mechanical mixing of the hot metal and desulfurization agent. Thus, the rapid rotation of the impeller physically promotes the desulfurization reaction efficiently, and allows low-cost lime to be utilized as the desulfurization agent instead of expensive and hazardous magnesium, significantly reducing operating costs as well as

storage/handling precaution compared to the injection process where the desulfurization agent is blown in via a submerged lance.



Fig. 1 Impeller in action

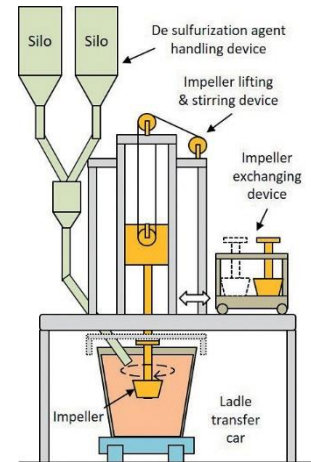


Fig. 2 Configuration of KR (fixed type)

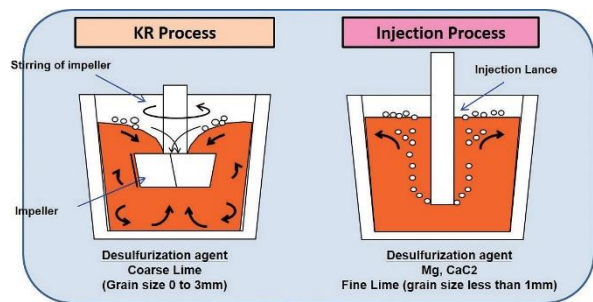


Fig. 3 Comparison of KR and injection processes

- 1) Excellent desulfurization performance
 - (1) Desulfurization ratio: 97% avg.*
 - (2) Concentration of sulfur after desulfurization: 10ppm or less*

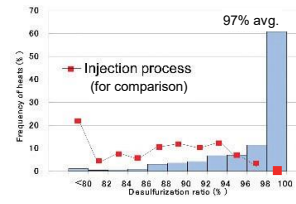


Fig. 4 Desulfurization ratio

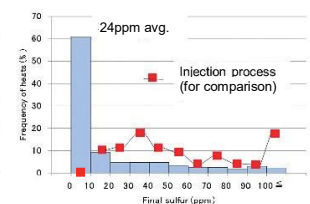


Fig. 5 Concentration of sulfur after desulfurization

- 2) Low desulfurization cost

Operation costs are approximately 45% lower than use of magnesium for desulfurization*.

*: Actual figures from plant in India

3 Features of Nippon Steel Engineering Technology for Movable KR

The movable KR provides a mechanism for raising and lowering the impeller, and desulfurization agent hoppers are mounted on a movable technological structure. This feature enables desulfurization process to be performed in multiple locations.

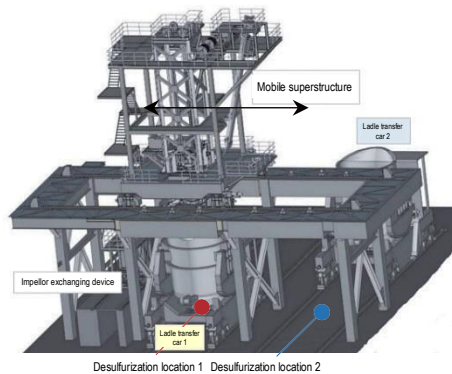


Fig. 6 Movable KR

1) Benefits

- (1) Single KR unit can perform desulfurization at multiple locations, thus capital cost is less than installation of multiple fixed KR's.
- (2) Capability to perform desulfurization and slag removal in parallel from multiple locations at the same time, and shortening the processing time.
- (3) Mixture of movable and fixed type KR's provides greater freedom in plant layout and the flexibility to satisfy customer's challenges, such as space constraints, etc.

2) The Design

The movable type KR design requires countermeasures to vibrations generated from the rapid rotation of the impeller. As the movable technological structure runs on rails attached to a fixed structure, a secure mechanism for locking the movable technological structure to the rails/fixed structure is the most critical element within the design. Optimization of weight and frame stiffness of the movable technological structure were also important elements. To this end, Nippon Steel Engineering developed a structural analysis model of the entire equipment including the structures (movable and fixed) for conducting thorough vibration analyses. This

model is the basis for designing the KR with minimum vibration.

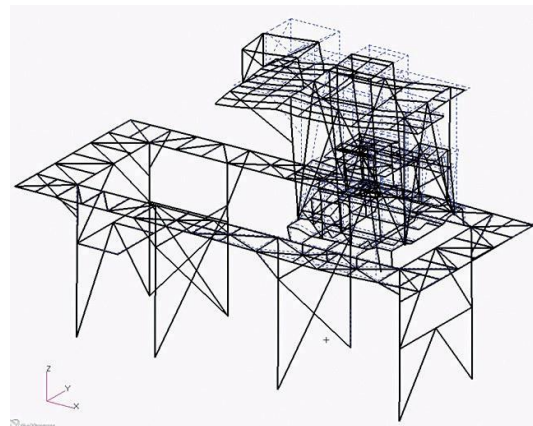
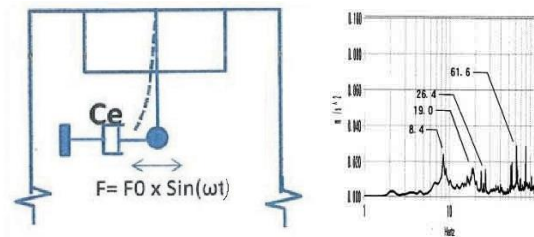


Fig. 7 Vibration analysis model

4 Conclusion

Nippon Steel Engineering is capable of supplying both fixed and movable type KR's with optimum design, including security to vibration. This is due to not only the numerous experience and supply records in the industry, but also its own proprietary design practices. In the future, Nippon Steel Engineering intends to provide solution to customer challenges for high-grade steel production through its distinctive KR's, not just in India but also worldwide.

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