

# **Efficient, Economical & Ecological Hot Metal Desulphurisation Solution for Iron and Steel Industries**

Asha Kumari, Amit Banerjee, Madan Mohan Mahato,  
Deepak Kumar Agrawal, Adarsh Agrawal  
JAMIPOL Limited, Namdih Road, Burmamines, Jamshedpur-831007  
Email : asha@jamipol.com, deepak.agrawal@jamipol.com, madan@jamipol.com,

## **Abstract**

With an increasing demand of low sulphur high quality steel and the inadequacy of low sulphur content raw materials used in blast furnace, there has been an increased demand for hot metal desulphurisation externally. Ladle based hot metal desulphurization is done with the help of reagents like magnesium, carbide based compounds and lime. Different types of External Desulphurization techniques are used nowadays and are frequently adopted by the steel makers. Some of the important techniques are mono-injection, co-injection and multi-injection. The performance of these techniques depends on various parameters, one of which is the type of reagent used. Selection of the reagents and the ratio to be used, depends on the hot metal quality, requirement of sulphur, available cycle time, etc.

In mono injection process, the salient features are low capital and maintenance cost, higher injection time and simple operation. In co-injection, there is a consistency of injection, no segregation issues, faster operation, and aims at lower operating cost. In multi injection system, the salient features are sequenced injection for higher reagent efficiency & low cost, enables independent injection of slag conditioners, reduced operation cost and reduced iron losses.

During recent years, several innovative methods have been introduced to reduce the desulphurization cost. JAMIPOL has come up with a Model called TDSM which provides total DS Solution to iron and steel industries and we had set a benchmark by reducing total DS cost from around Rs. 200 - 250 per tonne to around Rs. 100 - 150 per tonne of hot metal by improving and optimizing various parameters like reagents efficiency, lance designing, flow rate of DS reagents, metal loss, "S" reversal, refractory consumption, N<sub>2</sub> consumption, temperature losses etc.

**Keywords:** External hot metal desulphurization, cycle time, TDSM

## **Introduction**

Sulphur is one of the most detrimental impurities in the steelmaking process, affecting both internal and surface quality. High percentage of sulphur in steel injures the rolling qualities of steel, causing it to crack and tear, and lessening its capacity to weld. Therefore, sulphur from hot metal is reduced before being charged into the converter by Deep Injection Process.

Different types of External Desulphurization techniques are used nowadays and are frequently adopted by the steel makers. Some of the important techniques are – mono-injection, co-injection and multi-injection. The performance of these techniques depends on various parameters, one of which is the type of reagent used. Depending on the quality of hot metal used and environmental consideration currently, deep co-injection of carbide based DS compounds; magnesium and lime are proven successful methods of desulphurizing hot metal that offers steel producers a reliable, repeatable and economical means of meeting the market demand.

In present era with increasing competition, to sustain steel industries in global steel market they have to lower down the production cost. Several innovative methods have used to reduce desulphurization cost and these efforts cover through an innovative solution provided by JAMIPOL called “TSDM” (Total DS Management Model).

## **Total DS Management Model**

Sulphur element for most of the high end steel products. To achieve the desired level of low sulphur, iron & steel makers prefer external hot metal DS route worldwide. This is a well established technology and many steel makers are utilizing this technology. Outsourcing is one of the key initiatives which most of the steel makers prefer nowadays. In the last couple of years, JAMIPOL has developed an innovative “Total DS Management model” to address the above requirements of steel makers. Through this model Indian steel makers now can outsource the external DS operation & maintenance on cost per ton per point sulphur drop basis. This model helps steel makers to achieve the desired level of sulphur with some reduction in operating cost.

It has been seen that in the last couple of years, steel makers are outsourcing their maximum activity to concentrate more on core steel making activity. Keeping this requirement in mind, JAMIPOL team has developed innovative “Total DS Management” model. “Total DS Management” is a cost guarantee model which takes care of both cost & desired quality.

In India, JAMIPOL is known as the best technology solution provider for external hot metal desulphurization. Being in this field for more than 16 years, JAMIPOL has a large data bank and technical capability to address any kind of problem related to external hot metal desulphurization. JAMIPOL is currently the market leader in India for external hot metal desulphurization.

In “Total DS Management” model, JAMIPOL operates the DS Station which is installed by the steel makers. This model also takes care of the following important process parameters.

- The specific DS cost is considered to be a very important parameter which directly controls the operational cost of the DS Station. It is calculated based on the cost of treatment per ton of hot metal per point sulphur drop
- Cycle time is the time required for doing DS of a heat which needs to be adjusted as per logistics of the steel making shop.
- The loss of temperature due to external DS operation.
- The process of sulphur reversal is directly related to the de-slagging efficiency of the external DS operation
- Metal loss is the loss of metallic Fe during the process of de-slagging of DS Slag
- The percentage sulphur achieved as compared to that of the target level is known as strike rate.
- In case of DS operation lance life is normally measured in terms of minutes of operation during the injection of compounds

After hot metal produced in blast furnace / COREX, this hot metal comes to DS Station for doing external hot metal desulphurization. Through “Total DS Management” model JAMIPOL treats the hot metal and ensures the required level of sulphur range in the treated hot metal. Following which, this treated low sulphur hot metal is sent to the steel melting shops for further treatment. Through this model JAMIPOL provides sustainable solution to steelmakers. By following this model, steelmakers can now assure themselves that they will get the desired sulphur in hot metal from treated hot metal in DS Station. This model includes both operation & maintenance of DS Station.

However, the option of only operation service with specific targets is also available in this model. In this model cost of treatment is simplified as “Cost per ton per point sulphur

drop”. This also helps steelmakers to easily monitor the DS cost. Along with low operating cost of DS & consistent sulphur level, this model also ensure low metal loss, low cycle time, low temperature loss, sulphur reversals etc. which also give direct benefits to steel makers.

### Benefits of Total DS Management Model

Following are some of the benefits of Total DS Management model.

Reduction in operating costs for sulphur management.

- Assurance of consistent sulphur after treatment from external treatment process
- Steel makers get more time for doing core steel making activity
- New approaches are adopted for DS process optimization

### Results and Discussion

- Specific consumption of both the DS reagents (Carbide based compound CAD and Magnesium MAG) at Location 1:

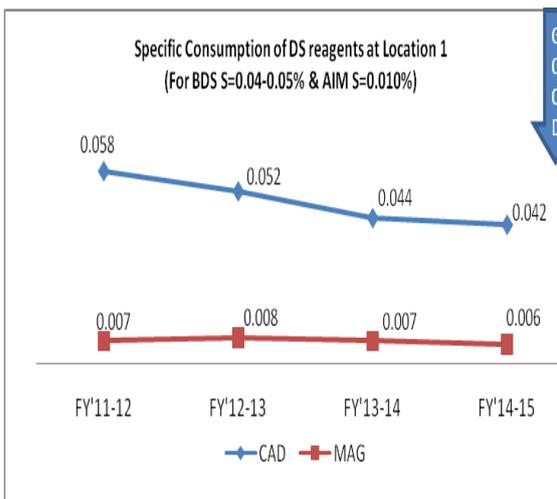


Fig 1

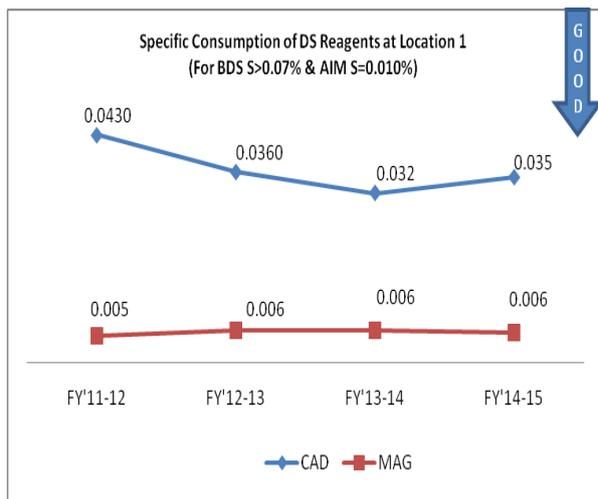
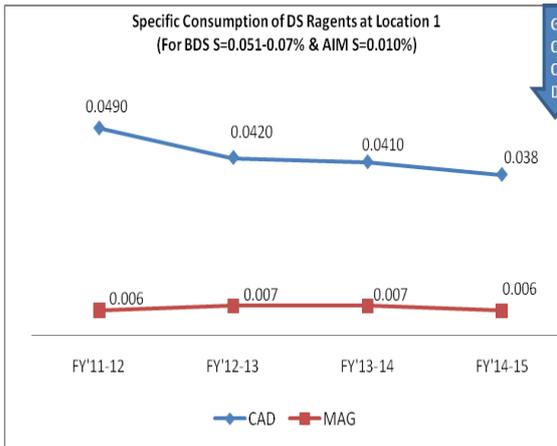
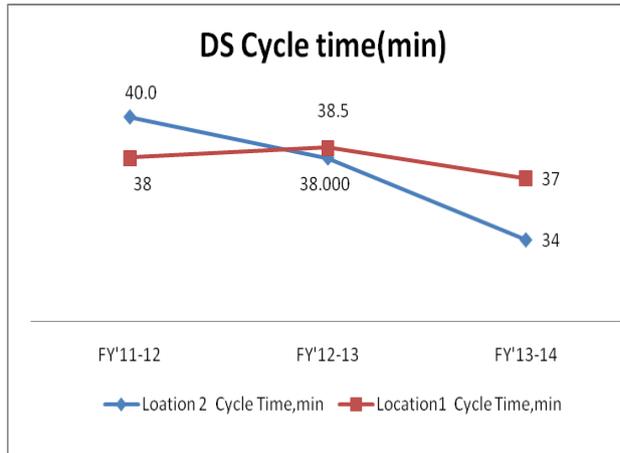


Fig 2



**Fig 3**



**Fig 4**

Fig 1, 2 & 3 shows specific consumption of both the DS reagents carbide based compound and Mag-97 at different levels of sulphur before desulphurization (BDS) from last three years has been reduced by optimizing the various operational parameters like reagents efficiency, lance designing, flow rate of DS reagents, metal loss, “S” reversal, refractory consumption, N<sub>2</sub> consumption, temperature losses etc. Fig 4 shows the decreasing trend in total cycle time of desulphurization process which directly linked with increase Productivity after implementing TDSM.

**Table A : Specific Consumption of DS Reagents where TDSM Model is established by JAMIPOL**

Specific Consumption of CAD & MAG at Location 1 FY11-12, 12-13, 13-14, 14-15									
AIM-.010		BDS less than .040		BDS .041 to .051		BDS .051 to .070		BDS More than .070	
		CAD kg/t/p oint of "S" Drop	MAG kg/t/poi nt of "S" Drop	CAD kg/t/p oint of "S" Drop	MAG kg/t/poi nt of "S" Drop	CAD kg/t/p oint of "S" Drop	MAG kg/t/p oint of "S" Drop	CAD kg/t/poi nt of "S" Drop	MAG kg/t/poi nt of "S" Drop
Location 1	FY 2011-12	0.061	0.0081	0.058	0.0069	0.049	0.0062	0.043	0.0054
	FY 2012-13	0.069	0.0104	0.052	0.0081	0.042	0.0068	0.036	0.0059
	FY 2013-14	0.062	0.0084	0.044	0.0068	0.041	0.0069	0.032	0.0056
	FY 2014-15	0.055	0.0075	0.042	0.006	0.038	0.0065	0.035	0.0055

In order to reduce the DS cost JAMIPOL had invented another lime based desulphurizing compound. Traditionally in India, to desulphurize, calcium carbide based reagents have been used which, however, are hazardous in nature. Overcoming this significant limitation, a new process to use fluidized lime replacing calcium carbide was developed by JAMIPOL. Fluidized lime is non-hazardous; more than 50% cheaper; made using by-product fines and has a potential of annual savings of more than Rs 50 Crores. Furthermore, the new process is environment friendly reducing the carbon footprint by eliminating manufacture of carbide along. Various successful trials have been conducted and established at our customer end.

### **Conclusion**

With the increasing steelmaking capacities across the globe combined with the diminishing availability of good quality raw materials, the steelmakers are facing a tough task. Hot metal with high inputs of 'S' has to be brought down as per the customer requirement which has become more and more demanding. With external DS in place it has been possible for the steelmakers to utilize the raw materials of whatever quality they have and then transform these to the desirable products. Now it is time for the DS compounds suppliers to become integral stakeholders with the steelmakers in providing solution not only in the form of compounds but also in the development and running of the DS stations. The success of external desulphurization is driven by interference of machine, men, material and method related philosophies which need to update with the course of time.

In India, JAMIPOL has come a long way from a DS compound supplier to being a complete DS solution provider. By applying this innovative solution, steel industries have reduced the total DS cost from around Rs. 200 - 250 per tonne to around Rs. 100 - 150 per tonne of hot metal by improving and optimizing various parameters like reagents efficiency, lance designing, flow rate of DS reagents, metal loss, "S" reversal, refractory consumption, N<sub>2</sub> consumption, temperature losses etc.