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Bulletin 782 - 09/11 - Mill Scale / Mill Scale Fines - Worldwide

Improvements in iron extraction processes have made steel producers take a second look at what they do with Mill Scale which is the by product of the steel making process. Mill Scale is not a common commodity to carriers and while is may not be covered by any steel industry code of practice it is covered by the marine industry IMSBC Code requirements. It should however be no surprise that as a commodity much likened to iron ore fines it is liable to liquefaction.

Mill Scale is formed during the steel making process as a means of providing a protective coating on hot rolled steel. During further processing the scale has to be removed and this process creates flakes of iron oxide. It is these flakes of Mill Scale that are being increasingly traded as a bulk cargo. While Mill Scale is deliberately formed in steel mills, it is treated as a waste product once it has been flaked off. Recycling this product has become possible due to changes in iron production methods as it can be mixed with other iron sources in smelters as well as with lower grade ores prior to shipping. **Mill Scale is traded effectively in the same manner as primary mined iron ore fines.**

The nature of the production methods are such that Mill Scale flakes form in a variety of particle sizes. In addition, in order to accumulate sufficient cargo for transport many shippers will stockpile the Mill Scale flakes from various sources, and this along with the low mechanical strength of the flakes so they easily break, means that such stockpiles are likely to be made up from varied particle sizes. If the hot steel is made into cast ingots (smaller than plates or sheets), or if Mill Scale is ground to reduce the size for industrial processing, the flakes are smaller hence the term Mill Scale fines is used. Mill Scale fines are largely used interchangeably with iron ore fines in steel processing.

However, the cargo is not listed in the IMSBC Code. Section 1.3 of the IMSBC Code specifies that unlisted cargoes, such as Mill Scale, should only be accepted for loading provided it is accompanied by a certificate issued by the national competent authority, stating the commodities suitability for seagoing carriage, of the country of the port of loading.

The physical nature of Mill Scale is similar to primary mined iron fines. IMO Circular DSC.1/Circ.63 of 12 October 2010 states that iron ore fines are a cargo that *may* liquefy (and are therefore a Group A cargo), and the terms of this circular should also be applied to Mill Scale. The Circular goes on to invite Member Governments to submit relevant information regarding the safe handling and carriage of this cargo, at their earliest convenience, to the IMO.

The IMSBC Code also warns about the potential liquefaction hazard of all fine-grained mineral cargoes shipped with inherent moisture content, regardless of whether or not the cargo is specifically identified as a Group A cargo in the Code. Appendix 3, para 2.1 of the Code states;

> "*Many fine-particled cargoes if possessing a sufficiently high moisture content are liable to flow. Thus any damp or wet cargo containing a proportion of fine particles should be tested for flow characteristics prior to loading*".

Mill Scale and Mill Scale Fines do have fine particle sizes with a significant inherent moisture content, and fall therefore within the scope of this provision. Therefore, Mill Scale cargoes should be treated as cargoes that may liquefy unless testing shows otherwise. For Group A cargoes, SOLAS and the IMSBC Code require shippers to provide the Master with a certificate of the moisture content and the transportable moisture limit (TML) prior to loading.

Dry appearance, wet base

In addition, Mill Scale often exhibits a 'wet base'. This occurs when the material drains well and accumulates water at the bottom of the stockpile. Because of this drainage, the upper sections can appear quite 'dry'. The wet base nature of Mill Scale makes it vital that any moisture sampling prior to loading does not just focus on the surface area of any stockpiles, and that a fully representative sample is taken. The need for representative sampling is also vital for the determination of the TML, particularly due to the variable nature of the material. In order to sample stockpiles mechanical excavators will be necessary as manually digging into the piles is impossible.

Permeability & Porosity

In any granular material, "porosity" is the property that describes the size and shape of the spaces between the particles, often referred to as the void space. "Permeability" describes how those pore spaces are connected and therefore how fluids will flow through them. A mineral cargo might have a low porosity while still having a high permeability. To develop a wet base, the permeability of mill scale will be quite high, and this can be put to good advantage by ensuring effective drainage around the stockpiles. Shippers should note that by draining any water away from the base of the stockpile, it is possible to achieve a significant reduction in the overall moisture content in a reasonable timescale. Reduction of

the moisture content may be the difference between the cargo being accepted for loading or not. Equally important is ensuring adequate covers are placed over the stockpiles to prevent rain reaching the cargo. Loading from barges is common place, and so adequate covers on barges prior to loading is essential.

Mill Scale and Mill Scale Fines tested to date have been found to possess a transportable moisture limit (TML) and have thus been confirmed as Group A cargoes. Members are advised not to load Mill Scale cargoes without first being in possession of a certificate from the shipper stating the moisture content and the TML.

Finally, due to the high density of this cargo, the trimming requirements as detailed in the Code are that it should be trimmed flat for the voyage to distribute the weight evenly across the tank top. Wet base cargoes are prone to cargo shift as the bottom liquefies and the top of the high-density stow becomes free to slide around over the wet base. The only remedy for that is to trim properly.

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