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Wet Abrasive Blast / Decontamination Chemical for Offshore Maintenance Coatings

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ABSTRACT

Dry abrasive blast is the most widely used surface preparation method in coating industries. However, dry blasting has several drawbacks – (1) dusting to cause environmental hazard and health concern, and (2) residual salt contamination remained. Residual salts are buried in the corrosion pits and difficult to clean off. The abrasive blasted steel surface will develop flash rust within a day in a 50% Relative Humidity atmosphere and just in a few hours in offshore saline environment. Even a slight amount of chloride salt contamination above 2 $\mu\text{g}/\text{cm}^2$ will be detrimental to coating performance, causing blistering, adhesion degradation, and underfilm corrosion to result in a short service life, particularly for the immersion service, such as pipeline coatings or tank linings.

Recently several new types of wet abrasive blast equipment have been developed in the market for dust reduction. The rust inhibitors or decontamination chemicals must be added into the abrasive blast water solution to prevent flash rust and reduce residual salts. There are several decontamination chemicals in conjunction with the newly developed wet abrasive blast equipment. Four decontamination chemicals with wet abrasive blast machines were studied. It was found that they indeed reduce both dusting and residual salts and improve flash rust resistance.

Key words: wet abrasive blast, decontamination chemical, chloride, flash rust, garnet

INTRODUCTION

Dry abrasive blast is the most widely used surface preparation method in coating industries. However, it has two major drawbacks – (1) dusting to cause environmental hazard and health concern (silicosis), and (2) residual salt contamination remained. Residual salts in the range of 5-65 $\mu\text{g}/\text{cm}^2$ remain in the corrosion pits and are difficult to clean off by dry blasting alone. The blast cleaned steel surface will develop flash rust within a day in a 50% Relative Humidity atmosphere and just in a few hours in offshore saline environment. Even a slight amount of chloride salt contamination above 2 $\mu\text{g}/\text{cm}^2$ will be detrimental to coating performance, causing blistering, adhesion degradation, and underfilm corrosion to result in a short service life, particularly for the immersion service, such as pipeline coatings or tank linings¹.

In coating industries, there have been several attempts to develop wet abrasive blast equipment to reduce dusting. SSPC and NACE have issued a joint technical report² on Wet Abrasive Blasting. In the report several wet abrasive blast equipment – water ring, coaxial water injector, and slurry blaster were developed earlier without much acceptance in the coating industries.

Recently several new types of wet abrasive blast (WAB) equipment have been developed for surface preparation. The rust inhibitors or decontamination chemicals must be added into the abrasive blast water solution to prevent flash rust and reduce residual salts. There are several decontamination chemicals available in the market to be used in conjunction with the wet abrasive blast equipment. Joshua Bell and Casey McCartney³ have reported the success in the use of the newly developed wet abrasive blast equipment.

The purpose of this work is (1) Part 1 - to evaluate the salt decontamination capability and the flash rust resistance of the newly developed wet abrasive blast equipment and (2) Part 2 – to study the compatibility of the decontamination chemicals with the coating systems and the impact on the long term performance of offshore coatings in atmospheric condition and in immersion condition. Here in this paper, we only report the test results on Part 1.

WET ABRASIVE BLAST (WAB) EQUIPMENT

Recently several new types of wet abrasive blasting equipment were introduced to the coating industries. Water and abrasives (i.e., garnet) are mixed in the pot or in the air hose so that the abrasive particles are covered with water, which makes the abrasives heavier to fall and to reduce dusting. The dust reduction has been studied by a major application equipment company and found 91% reductions⁴ in weight of total airborne particulates for garnet abrasives. There are two types of wet abrasive blast equipment and they are described in Table 1. They have the same function to inject wet slurry into the air hose or to inject water to the air hose to mix with abrasives to blast steel substrates. They can reach the same result to clean the steel surfaces. Garnet abrasive is the most popular abrasive in practice.

Table 1 Two Types of WAB Equipment

Type 1 WAB Equipment	Garnet abrasives are poured into the abrasive pot and pressurized with air. Abrasives are injected into the rubber hose by the air pressure and use 5 - 20 psi pressure differential to inject the water mixed with the decontamination chemical into the air rubber hose. The right ratio of decontamination chemical is mixed with potable water in a water container. If the water valve is closed, it can be used as a dry blaster.
Type 2 WAB Equipment	Garnet abrasives are poured into the abrasive pot to wet out with potable water mixed with the decontamination chemical into a slurry. The pot is pressurized with 115 psi air pressure. A potable water tank is used to store the water mixed with the decontamination chemical. Using a water pump with 20 psi higher pressure to inject the wet abrasives into the air rubber hose to blast steel.

DECONTAMINATION CHEMICALS

There are four salt decontamination chemicals studied in this work, as listed in Table 2. The decontamination chemicals with several proprietary additives have three functions:

(1) Surfactant to reduce water surface tension

The surface tension of water is 72 dynes/cm. One of the additives is the surfactant to reduce the water surface tension to wet the steel surface. The abrasive blasted steel surface still has craters, crevices, and pits. The water with lower surface tension will be much easier to penetrate these craters, crevices, and pits to dissolve the salts.

(2) Dislodge the salt – steel ionic bond

The chloride ion reacted with iron to form ionic bond which takes some effort to dislodge. The additive has the function to loosen the salt-steel bond.

(3) Passivation to improve flash rust resistance

One of the additives will form a passivation film to mitigate the corrosion and improve the flash rust resistance. However, the passivation film is very thin with a very limited corrosion resistance capability and not last a long time. Compatibility of this thin layer of additives with the coating system is a concern and the coating compatibility shall be evaluated.

Table 2 Commercial Decontamination Chemicals

Product Name	Water/Chemical ratio	Water Type	Steel Substrate
Chemical R	50-100 /1	(1) Potable water, < 420 μ S/cm (2) Potable water, 730 μ S/cm (3) DI water, 1-165 μ S/cm	Grade D rusted carbon steel
Chemical H	50-100/1		
Chemical C	100/1		
Chemical O	100/1		

TEST PANEL PREPARATION

The ASTM A36 carbon steel panel of 3 x 6 x 3/16 inches (75 x 150 x 5 mm) were dry grit blasted to SP-10 near white metal finish, then they were rusted in the salt fog chamber for 4 weeks in