SSPC-TR 2/NACE 6G198

JOINT TECHNICAL REPORT

Wet Abrasive Blast Cleaning

SSPC: The Society for Protective Coatings (SSPC) and NACE International (NACE) issue this report in conformance with the best current technology regarding the specific subject. This report represents a consensus of those individual members who have reviewed this document. It is intended to aid the supplier, the user and the general public. Its acceptance does not in any respect preclude any person or organization, whether they have adopted the report or not, from manufacturing, marketing, purchasing, or using products, processes, or procedures not in conformance with this report. Nothing contained in this report is to be construed as granting any right, by implication or otherwise, to manufacture, sell, or use in connection with any method, apparatus, or product covered by Letters Patent, or as indemnifying or protecting anyone against liability for infringement of Letters Patent. This report represents minimum requirements and should in no way be interpreted as a restriction on the use of better procedures or materials. Neither is this report intended to apply in all related cases. Unpredictable circumstances may negate the usefulness of this report in specific instances. SSPC and NACE assume no responsibility for the interpretation or use of this report by other parties and accept responsibility for only those official interpretations issued by SSPC or NACE in accordance with their respective governing procedures and policies, which preclude the issuance of interpretations by individual volunteers.

Users of this report are responsible for reviewing appropriate health, safety, and regulatory documents and for determining their applicability in relation to this report prior to its use. This SSPC/NACE report may not necessarily address all safety problems and hazards associated with the use of materials, operations, and/or equipment detailed or referred to within this document.

CAUTIONARY NOTICE: SSPC/NACE reports are subject to periodic review and may be revised or withdrawn at any time without prior notice. SSPC and NACE require that action be taken to reaffirm, revise, or withdraw this report no later than five years from the date of initial publication. The user is cautioned to obtain the latest edition. For information on this and other joint SSPC/NACE publications, contact either organization. The SSPC Publications Dept. may be reached at 40 24th Street, Pittsburgh, PA 15222-4656 (telephone +1 412-281-2331). The NACE International Membership Services Dept. may be reached at P.O. Box 218340, Houston, Texas 77218-8340 (telephone +1 281-228-6200).

Foreword

This joint report was prepared by the SSPC/NACE Joint Task Group C on Wet Abrasive Blast Cleaning, which is comprised of members of both the SSPC Surface Preparation Committee and the NACE Unit Committee T6G on Surface Preparation. It is intended to be used primarily by specifiers, owners, painting contractors, inspectors, and others involved in surface preparation of industrial structures.

1. Scope

This document covers procedures, equipment, and materials involved in a variety of air/water/abrasive, water/abrasive, and water-pressurized abrasive blast cleaning systems. Equipment usage and safety are also discussed.

2. Description and Use

2.1 Air/water/abrasive blasting is a cleaning method in which water is injected into the air/abrasive stream generated by conventional air-pressurized abrasive blasting equipment.

2.1.1 Water helps to remove contaminants from the substrate, to wet the abrasive, and to substantially reduce dispersion of fine particulates (dust). Particulates are often caused by the breakup of the abrasives, surface corrosion products, and paint if the surface has been previously painted. Dust suppression is achieved by thoroughly wetting the abrasive and other particles to encapsulate them with a thin film of moisture. The objective is to remove contaminants and suppress the dusting effect caused by the impact of the abrasive on the substrate, while retaining the blasting characteristics of dry abrasive, including creation of anchor profile.

2.1.2 Air/water/abrasive blasting is an alternative to water jetting, dry blasting, and water blasting with abrasive injection.

2.1.3 Air/water/abrasive blasting is referred to hereafter as "wet blasting."

2.2 Water/abrasive blasting is a cleaning method in which abrasive is injected into the water stream generated by conventional fluid pumps.

COPYRIGHT 2003 NACE International

Information Handling Services, Tue Feb 11 10:59:54 2003

2.2.1 Water is the primary agent to remove the contaminants from the substrate. The abrasive is injected to help remove brittle contaminants and create a profile where necessary. Compared to wet blasting methods, water/abrasive blasting has a higher water to abrasive ratio. Dust suppression is achieved by the wetting of the abrasive and other particles. The objective is to remove contaminants with water and impact the abrasive on the substrate to retain the blasting characteristic of dry abrasive, including creation of anchor profile.

2.2.2 Water/abrasive blasting is an alternative to dry blasting, wet blasting, or water jetting.[1]

3. Procedures and Parameters

3.1 Wet blasting is generally considered suitable for use on any substrate for which the use of abrasive is appropriate. Wet blasting can often be adjusted to clean delicate substrates.

3.2 Some wet blasting systems can utilize the same wide variety of available abrasives as conventional dry abrasive blast systems. Wet abrasive is more difficult to recycle than dry abrasive. In some cases, recycling of wet abrasive may not be possible. In some cases, the water may be recycled.

3.3 The water flow rate and the ratio of water to abrasive are usually adjustable so that a wide range of applications, from washing of surface contaminants to white metal blast, can be accomplished.

3.4 After wet blasting, all traces of abrasive and other loose particles are brushed, blown off with clean dry air, vacuumed, washed, or otherwise removed from the surface. Cleanliness of the surface cannot be overemphasized.

3.5 The injection of water to the air/abrasive stream helps to remove contaminants such as dirt and water-soluble salts, including ferrous, chloride, or sulfate salts.[2]

3.6 Inhibitors can be used to control flash rusting during wet or water/abrasive blasting. Many coating manufacturers prefer that inhibitors not be used in wet or water/abrasive blasting. (See Section 6.)

3.7 Production rates vary due to variations in surfaces being blasted, the type of abrasive used, and the level of fine particulate dust suppression desired. Systems introduced since 1985 claim production rates equal to or higher than conventional dry blasting, but independent studies have not been published as of this publication date.

3.8 Wet blasting is a process that can produce surface cleanliness and anchor profiles (surface roughness) similar to those obtained with dry blasting. The level of surface preparation specified is the same as that specified if dry blasting was the process being used. However, because the visual appearance of wet blasted surfaces is not necessarily the same as the visual appearance of dry blasted surfaces, care and judgment should be exercised by inspectors. It is common to encounter difficulty when visual inspection standards or aids prepared for dry blasting are used as inspection or judgment criteria for wet blasted surfaces. This visual difficulty can be lessened by preparation of a test patch which is agreed upon by the concerned parties during a pre-job conference.

4. Wet Blasting Equipment

4.1 The equipment used for wet blasting generally consists of conventional dry abrasive blasting equipment supplemented with modules to inject water into the abrasive stream. Ideally, the water encapsulates the abrasive particles with a thin film of moisture to suppress and contain the dust generated by the impact of the abrasive with the substrate. Abrasive injection into water blast equipment will also be discussed.

Systems are available that allow the operator to select adjustable rates of air, water, or abrasive as necessary to achieve optimum results. Some systems allow independent adjustment of each of these parameters while the system is in operation. Some systems also allow independent adjustment for each nozzle for multi-nozzle setups.

4.2 TYPES OF WET BLASTING SYSTEMS

4.2.1 General Requirements of Wet Blast Units: Most systems under the general classification of wet blast units contain a conventional dry abrasive blast pot with OSHA/NIOSH required deadman and other safety features, plus the normal complements of abrasive metering valve(s), compressed air inlet valve(s), blast hose, dry abrasive blast nozzle, etc. With these systems, the compressed air volumes and pressures are the same as for conventional dry abrasive blasting. Each of these systems can clean to SSPC-SP 5/NACE No. 1 (White Metal) and create a suitable anchor pattern for paint adhesion.

---

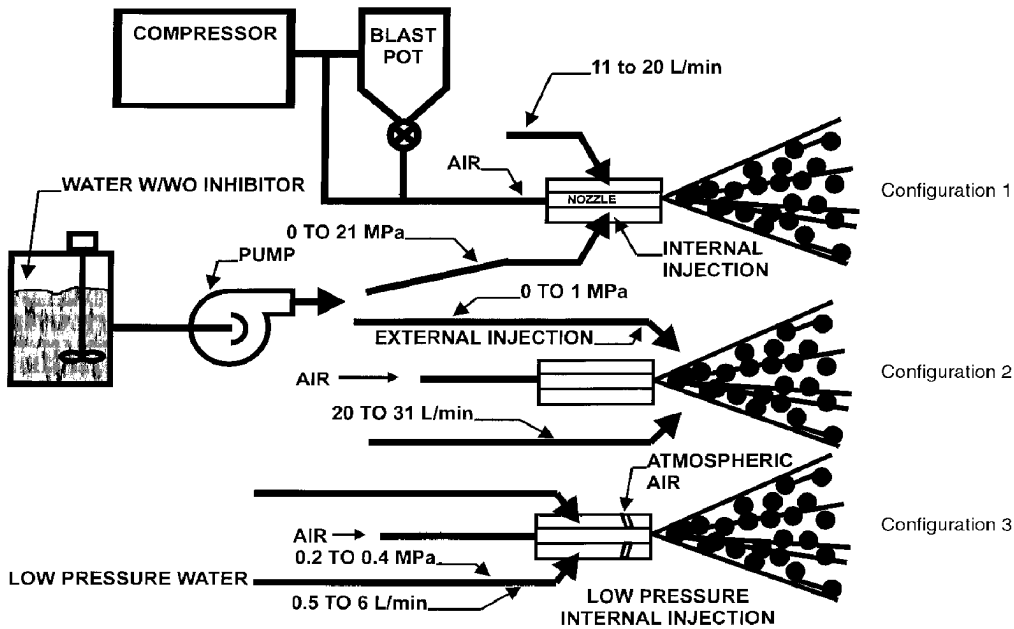
[1]Water jetting is defined in NACE No.5/SSPC-SP 12 as "the use of standard jetting water at high or ultrahigh pressure to prepare a surface for recoating using pressures above 70 mPa." Standard jetting water does not contain sediments or abrasive media.

[2]See NACE Publication 6G1-86 (latest revision), "Surface Preparation of Contaminated Steel Surfaces," and other items in the Bibliography.

COPYRIGHT 2003 NACE International

Information Handling Services, Tue Feb 11 10:59:54 2003

FIGURE 1



4.2.2 Radial Water Injectors: Some of these are commonly referred to as "water rings,"and are available in three basic configurations. In the first configuration, water is injected at an angle toward the center of the blast stream as the air/abrasive stream enters the blast nozzle. The water is normally injected at or just above the pressure of the compressed air. (See Figure 1.) The second configuration is a "donut" that fits over the outside of the dry blast nozzle. Water is injected from around the outside of the blast stream radially inward at an angle toward the center of the blast stream as the air/abrasive stream exits the nozzle. The third configuration utilizes a wet blast venturi nozzle which allows water and atmospheric air to be inducted at midpoint in the nozzle behind the bore restriction.

4.2.3 Coaxial Water Injectors: In these systems the water is injected directly into the throat of the blast nozzle. The direction of water injection is parallel to the flow of the air/abrasive stream. The air/abrasive stream and the water stream have the same axis or center line. (See Figure 2.)

4.2.4 Slurry Blasters: The term "slurry blasting" is commonly used for the systems described in Sections 4.2.4 and 4.2.5. In these devices, the water is injected into the air/abrasive stream at some point substantially upstream from the blast nozzle. This allows the air/abrasive/water mixture to tumble for some distance in the blast hose to mix with and wet the abrasive. Typically, the water is injected at the blast pot abrasive metering valve or at a blast hose connection. Sometimes the water is injected at the connection point of the whip hose to the main blast hose. (See Figure 3, Configuration 1.)

In Figure 3, Configuration 2, the abrasive is loaded into a pressure vessel and simultaneously mixed with water. The vessel, loaded with the abrasive/water combination, is then pressurized using an integrated pump and the mixture is injected into the air stream. The unencumbered air flow reduces overall water consumption rates and provides good dust suppression. Wet abrasive can be reused in the configuration 2 system as long as the abrasive has not been crushed during the cleaning process and the material being removed in the blasting process is non-hazardous.

4.2.5 Water Blast with Abrasive Injection: These devices differ from the units described in Sections 4.2.2 through 4.2.4 in that the propelling force is the water stream, not compressed air. This method is commonly referred to as "abrasive wet jet" or "AWJ", or "slurry blasting." The typical devices consist of a fluid pump with a venturi nozzle of some type in which the water flow draws the abrasive into the water stream or the abrasive media is injected into the water stream under pressure. Because the fluid stream is well defined, these devices usually cut a narrow blast pattern. (See Figure 4.)

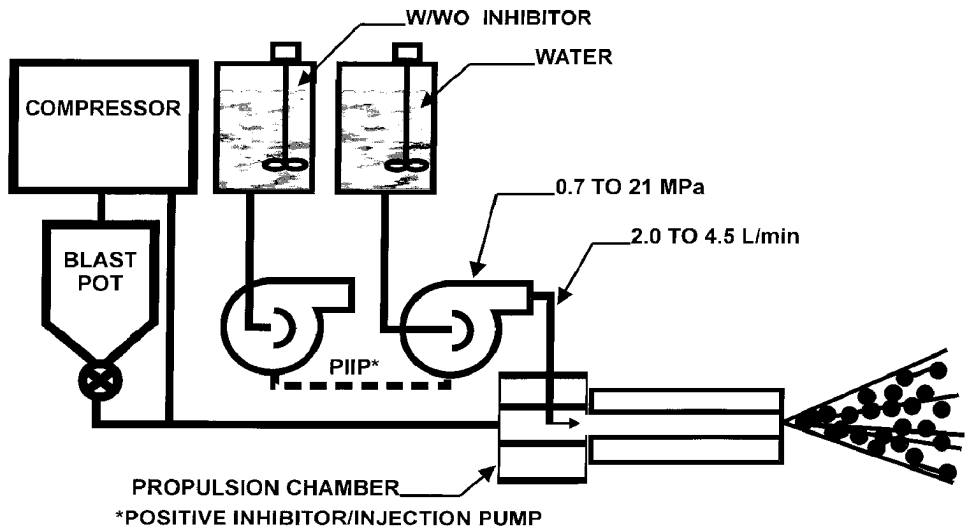
4.3 WATER DELIVERY SYSTEM

4.3.1 Purity of Water: The purity of the water used for wet abrasive blasting (or any wet cleaning method) can affect the quality of the cleaned substrate. To achieve a clean substrate, demineralized, potable, or other water that will not impose additional contaminants on the surface being cleaned is acceptable. There is no current definitive number

COPYRIGHT 2003 NACE International

Information Handling Services, Tue Feb 11 10:59:54 2003

FIGURE 2



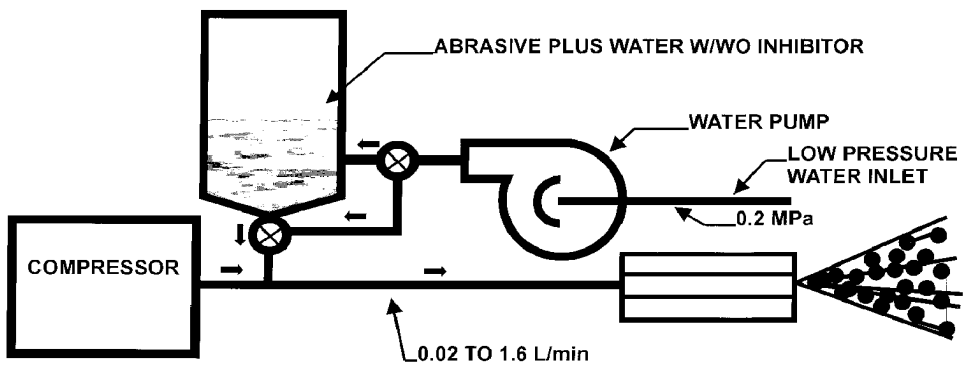


FIGURE 3, Configuration 1

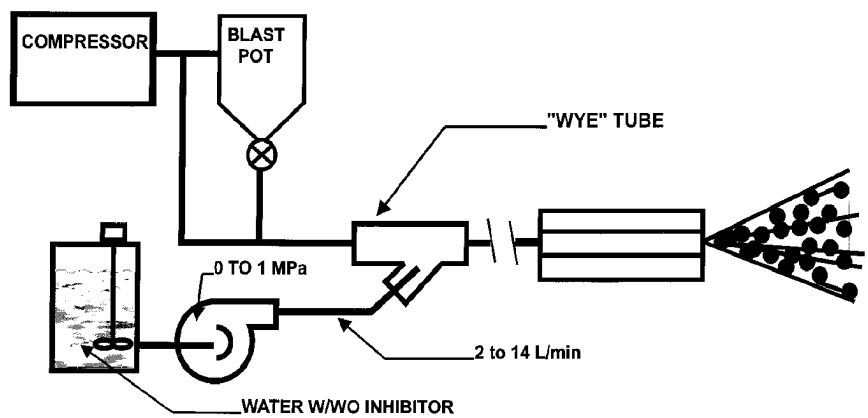


FIGURE 3, Configuration 2

COPYRIGHT 2003 NACE International

Information Handling Services, Tue Feb 11 10:59:54 2003

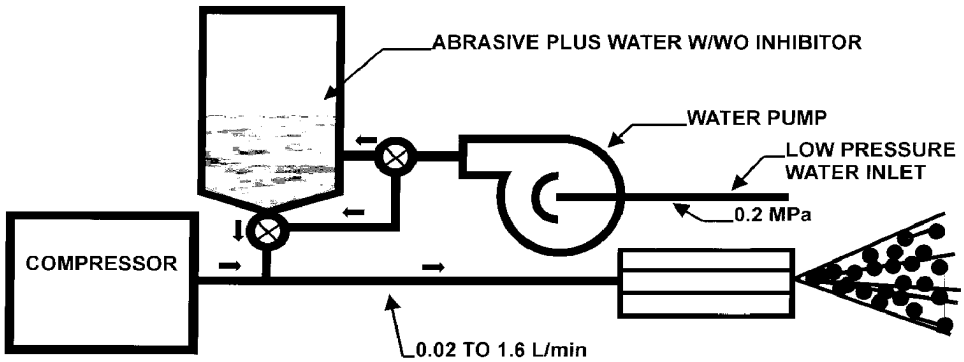
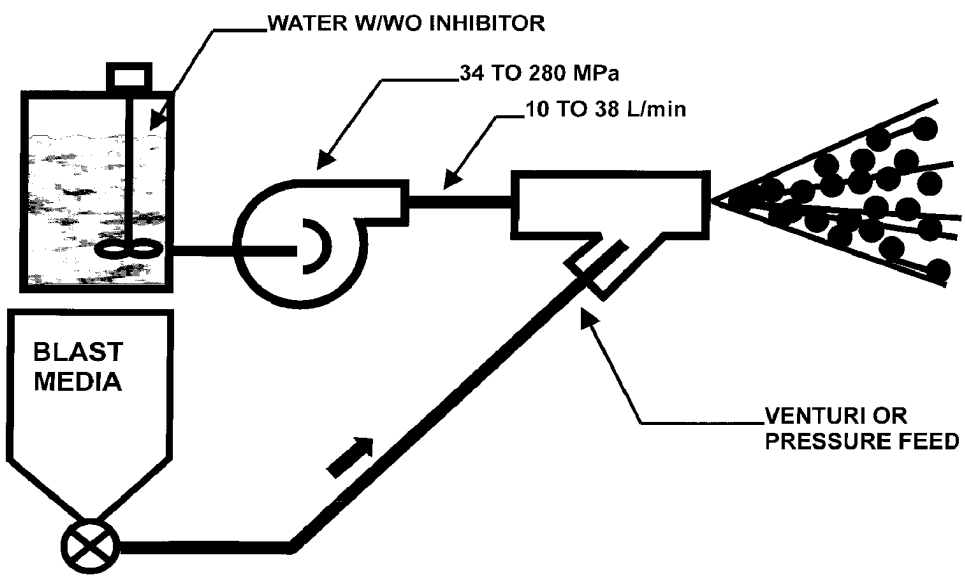


FIGURE 3, Configuration 3

FIGURE 4



for acceptable levels of water purity. The quality contamination of the substrate may be tested and confirmed. Recycled water may contain a buildup of contaminants.

4.3.2 Water Flow Rates Requirements: The system has sufficient water inlets with filters at the suction side of the pump to provide an adequate supply of water to the pump . The pump is capable of providing the water pressure at the required flow rates of the type of wet blast injector being used. Typical water flow rates and water pressures are:

a. Radial Water Injectors: 0.5 to 31 L/min (0.2 to 8 gpm) at 0.2 to 21 MPa (25 to 3,000 psi)
b. Coaxial Water Injectors: 2 to 4 L/min (0.5 to 1 gpm) at 0.7 to 21 MPa (100 to 3,000 psi)
c. Slurry Blasters (Figure 3, Configuration 1): 2 to 4 L/min (0.5 to 3 gpm) at 0.7 MPa (150 psi); Figure 3, Configuration 2, 0.02 to 1.6 L/min (0.0005 to 0.4 gpm) at 0.2 MPa (25 psi)
d. Water Blast with Abrasive Injection: 10 to 38 L/min (2.5 to 10 gpm) at 34 to 280 MPa (5,000 to 40,000 psi)

COPYRIGHT 2003 NACE International

Information Handling Services, Tue Feb 11 10:59:54 2003

4.3.3 Inhibitors: Where inhibitors are used, typical inhibitor/water ratios range from 1:1 to 1:1000. The inhibitor injector can be positively interlocked to the water pump to provide a uniform metered supply and constant concentration of inhibitor in the blasting water or mixed in a reservoir water supply. Other techniques, such as addition of inhibitor to a reservoir, can be equally efficient. The inhibitor or wet blast equipment supplier or manufacturer sometimes sets forth special recommendations. (See Section 6.)

5. Selection of Abrasives

5.1 GENERAL: Virtually any type of abrasive commonly used with conventional dry blasting can be utilized with the radial and coaxial injection type wet blasting devices (Sections 4.2.2 and 4.2.3), because they are supplemental to conventional blast equipment and the abrasive is not wetted in the blast hoses. (See SSPC-AB 1, "Mineral and Slag Abrasives.")

5.2 The following are some considerations when selecting an abrasive:

5.2.1 Salt Content: The salt content of abrasives can contaminate a blast cleaned surface.

5.2.2 Hardness and Sharpness: The harder and sharper the abrasive particles, the higher the productivity of the operators.

5.2.3 Particle Size: Utilizing a larger particle size decreases the tendency to create mud in corners and tight spots.

5.2.4 Mud Caking in Slurry Blasters: Development of "mud caking" in the blast hose in Figure 3 Configuration 1 (Section 4.2.4) causes frequent clogging of slurry blasters with many types of abrasives. Therefore, only abrasives which contain low levels of water soluble materials and which are not easily crushed are used with this type of slurry blasting equipment.

6. Inhibitors

6.1 PREVENTING FLASH RUSTING: Surfaces cleaned by water tend to flash rust. The rate of flash rusting depends upon how long the surface stays wet, ambient conditions such as temperature and relative humidity, purity of the water, contaminants remaining on the surface, and contaminants in the abrasive. Inhibitors retard the rate of flash rusting. CAUTION: Inhibitors may mask contaminants on the surface or introduce residues that interfere with coating performance.

6.2 REGULATIONS: Inhibitors complying with relevant federal, state, and local regulations are used.

6.3 COMPATIBILITY WITH COATING: Consult the coating supplier to make sure the inhibitors used do not interfere with the cure or the coating performance. Consult ASTM D 5367, "Standard Practice for Evaluating Coatings Applied over Surfaces Treated with Inhibitors Used to Prevent Flash Rusting of Steel When Water or Water/Abrasive Blasted" for information on compatibility of inhibitors with coatings.

6.4 USAGE: Inhibitors can be used in either the blast water or rinse water. The inhibitor manufacturer is consulted for specific usage recommendations.

7. Operation of Equipment

7.1 GENERAL: The equipment start-up sequence, operation, and preventative maintenance are followed in accordance with the manufacturer's instructions and the procedures listed in Section 7.2. The safety guidelines listed in Section 8 of this document and the safety requirements of 29 CFR 1910.94 and 1910.1000 are also observed.

7.2 EQUIPMENT START-UP SEQUENCE, OPERATION, AND MAINTENANCE:

7.2.1 All equipment (including gauges and controls) is checked to verify that it is clean and is operating properly before work is started. The system is tested to the maximum working pressure to ensure integrity of the connections.

7.2.2 The air, water, and abrasive blast hoses are checked to ensure that they are not frayed, kinked, or worn. This is essential for operator safety, because a blow-out could be very hazardous.

7.2.3 The water supply is filtered or otherwise treated to remove contaminants that could damage pumps and valves or leave corrosive deposits on the surface being cleaned.

7.2.4 As in conventional dry abrasive blasting, the hose size is as large as practical for the operator to handle, and as short as feasible to reduce the pressure drop from the pressure source to the nozzle.

7.2.5 Clean and dry abrasive is used.

7.2.6 Water pressure and flow rate are set to maximize production while suppressing the excessive generation of fine particulates. Increasing the water flow rate above the optimum often has a negative effect on productivity by cushioning the impact of the abrasive particles, rather than increasing cleaning rates significantly. (See Section 4.3.2 for water flow rates.)

COPYRIGHT 2003 NACE International

Information Handling Services, Tue Feb 11 10:59:54 2003

7.2.7 The nozzle distance to the work piece and the angle of incidence are adjusted to optimize cleaning rates. Heavier rust and tightly adherent materials are often more effectively removed by holding the nozzle closer to the work piece. An 80°-90° angle of attack has also been found to enhance the removal of this type of material.

7.2.8 Some specialized procedures for using the wet blast equipment consist of utilizing a relatively short sand-blast whip line (with a diameter slightly larger than normal) and a blast nozzle that is one size larger than is used with conventional dry blasting. The water injector is kept as close to the blast nozzle as possible to minimize mud caking in the blast hose.

8. Safety Guidelines

8.1 The fine particulates and mist from the impact of the abrasive upon the substrate contain dust particles similar to those found in dry abrasive blasting. The concentration of particulates is, however, lower in wet blasting. Nonetheless, take precautions to avoid inhalation of particulates from blasting that may remain in the air for a considerable amount of time.

8.2 The wet blast procedures follow all the safety guidelines for conventional dry abrasive blast equipment. (See 29 CRF 1910.93 and 29 CFR 1910.1000.)

8.3 Only trained operators should be permitted to utilize the equipment. They are equipped with suitable protection such as blast gloves, air-fed blast hoods, rain suits, foot protection, and hearing protection.

8.4 The nozzle should be pointed at the work surface only—never at personnel or other objects.

8.5 Water conducts electricity. Exercise caution around electrical equipment, wiring, or conduit. A safety professional should be consulted before beginning blast procedures.

8.6 All operation controls should be checked prior to work initiation.

8.7 Operators should wear required personal safety gear. They should establish a stable footing base and anticipate blast nozzle thrust and possible obscuring of vision prior to starting the blast.

8.8 Water runoff and blast debris should be handled in compliance with applicable safety and environmental regulations.

Bibliography

ASTM Standard D 5367, "Standard Practice for Evaluating Coatings Applied over Surfaces Treated with Inhibitors Used to Prevent Flash Rusting of Steel When Water or Water/Abrasive Blasted" (latest revision). West Conshocken, PA: ASTM.

Bleile, H. R., Rodgers, S. D., Porter, F., Smith, A. E., and Griffin, J. "Specification for Abrasive Blasting Media," Surface Preparation: The State of the Art, Proceedings of the SSPC Annual Symposium, May 1985, SSPC 85-06. Pittsburgh, PA: SSPC, 1985.

Chandler, K. A. "The Influence of Salts in Rusts on the Corrosion of the Underlying Steel." British Corrosion Journal, Vol. 1, July 1966: pp. 264-266.

Code of Federal Regulations (CFR) 1910.94, "Ventilation" (latest revision). Washington, DC: Office of the Federal Register.

Code of Federal Regulations (CFR) 1910.1000, "Air Contaminants." (latest revision). Washington, DC: Office of the Federal Register.

Dasgupta, D., and Ross, T. K. "Cleaning of Rusty Steel for Painting," British Corrosion Journal, Vol. 6, November 1971: pp. 237-240.

Joint Surface Preparation Standard SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning" (latest revision). Pittsburgh: SSPC and Houston: NACE International.

NACE Publication 6G1-86 (latest revision), "Surface Preparation of Contaminated Steel Surfaces." Houston, TX: NACE International.

Soltz, G. C. "The Effect of Substrate Contaminants on the Life of Epoxy Coatings Submerged in Sea Water." National Shipbuilding Research Program Report, March 1991.

SSPC Standard SSPC-AB 1, "Mineral and Slag Abrasives" (latest revision). Pittsburgh, PA: SSPC.

Weldon, D. G. and Cain, T. A. "Salts: Their Detection and Their Influence on Coating Performance," Surface Preparation: The State of the Art, Proceedings of the SSPC Annual Symposium, May 1985. (SSPC 85-06). Pittsburgh, PA: SSPC, 1985.

Woodson, J. P., "Fundamentals of Wet Abrasive Blasting." Materials Performance 27, 10 (1988).

COPYRIGHT 2003 NACE International

Information Handling Services, Tue Feb 11 10:59:54 2003