



REMR TECHNICAL NOTE CS-ES-3.3

UNDERWATER CLEANING OF CONCRETE AND STEEL: POWERED HAND TOOLS

PURPOSE: To provide information on the use of hydraulic- and pneumatic-powered hand tools for effectively removing fouling and corrosion from underwater structures.

APPLICATION: Powered hand tools can be used by divers to effectively clean underwater surfaces prior to inspection, maintenance, and repair operations. These hand tools use a variety of rotary cleaning attachments, such as brushes and abrasive discs, to remove different types of fouling. The tools are best at removing light to moderate fouling from steel and concrete surfaces in freshwater environments. The Whirl Away rotary abrading tool described below is designed to remove moderate to heavy fouling from underwater concrete surfaces.

ADVANTAGES: Powered hand tools are safer to operate than waterjet cleaning devices and are relatively easy to operate and maintain. Powered hand tools are also less expensive than waterjet systems and are a significant improvement over such unpowered hand tools as scrapers, wire brushes, and chippers. Cleaning rates of 3 to 6 sq ft/min can be obtained, depending upon fouling amount, material, and operator experience.

LIMITATIONS: Brush bristles and disc abrasives tend to wear quickly, particularly when used to remove heavy or hard calcareous fouling. Additionally, it is often difficult, or even impossible, to clean limited-access areas with hydraulic-powered hand tools. Hydraulic supply hoses make maneuvering around the work site difficult for the diver. Also, the large number of commercially available cleaning attachments requires a diver to have considerable expertise to quickly select the best attachment for the job at hand.

PERSONNEL REQUIREMENTS: A trained and qualified scuba diver is required to operate powered hand tools underwater. Another person is required to operate and monitor the controls and performance of the power source.

EQUIPMENT DESCRIPTION: Hydraulic-powered hand tool cleaning systems consist of the following components: an oil-hydraulic power source, a hand-held rotary power tool, at least one type of cleaning attachment, and interconnecting supply lines and connectors. Pneumatic-powered tools can also be used; however, hydraulic tools are preferred since they provide constant closed-cycle power and are easier and safer to operate underwater.

Most hydraulic hand tools operate at 1,000 to 3,000 psi and 5 to 10 gpm. A typical hydraulic rotary power tool is the Stanley Hydraulic Grinder, Model GR 24. The GR 24 operates at 2,000 psi at 7 to 9 gpm and at 4,500 rpm at 9 gpm. This grinder can be used to power most rotary cleaning attachments.

Nylon bristle brushes are adequate for cleaning light and loose fouling found on steel and concrete surfaces in most freshwater environments. Abrasive discs are primarily designed to clean steel surfaces. Only abrasive discs (with aluminum-oxide or silicon-carbide abrasives) and steel wire brushes are harder than barnacles and tubeworms. However, these devices can also scratch surfaces and remove protective coatings.

The following abrasive discs and brushes (Figure 1) can effectively clean steel surfaces and are listed in order of cleaning aggressiveness:

- a. 6-in.-diam Clean 'N' Strip Cup Wheel, silicon-carbide abrasive, manufactured by 3M Company, St. Paul, Minnesota.
- b. 7-in.-diam Bradex brush, 0.060/46 grit, silicon-carbide abrasive imbedded in nylon bristles, manufactured by AB Tex Corp., Rochester, New York.
- c. 7- or 8-in.-diam Metal Conditioning Discs, coarse, aluminum-oxide abrasive, manufactured by 3M Company, St. Paul, Minnesota.
- d. 7- or 8-in.-diam Blend 'N' Finish Discs, medium, aluminum-oxide abrasive, manufactured by 3M Company, St. Paul, Minnesota.
- e. 7-in.-diam Bradex Brushes, either 0.040/80 grit or 0.022/120 grit, silicon-carbide abrasive imbedded in nylon bristles, manufactured by AB Tex Corp., Rochester, New York.

To effectively remove heavy, calcareous fouling from concrete surfaces the Whirl Away rotary abrading tool (Figure 2) manufactured by R. C. Collins, Inc., is recommended. The Whirl Away has seven sets of hardened steel cutters that rotate on their axles while the shaft of the hydraulic tool is rotating in the opposite direction. The flow of water passing through the tool keeps the rotating cutters free of debris and fouling. Seven bars attached to the outside housing of the tool break away the heavy shellgrowth and fouling, while the 49 rotating wheels remove the balance of the material. More than 3 in. of hard shell growth and 6 in. of sea growth can be removed at cleaning rates of 3 to 6 sq ft/min.

The Whirl Away attachment (Model 637-MA) weighs 4-1/2 lb (in the dry) and is 7 in. in diameter. Replacement cutters are available in sets of 49. A cleaning system requires a power source, a hydraulic (or pneumatic) rotary hand tool, a Whirl Away attachment, and interconnecting hardware, such as hoses and quick disconnects.

COSTS: The cost of purchasing a typical hydraulic-powered rotary hand tool for underwater use is approximately \$1,500. The cleaning attachments, such as brushes and discs, cost less than \$50 each. The Whirl Away rotary abrading attachment is approximately \$100. A hydraulic power source (78 gpm, 1,400 to 2,000 psi) costs approximately \$2,000 to \$6,000 depending upon the configuration (diesel or gas engine, trailer-mounted).

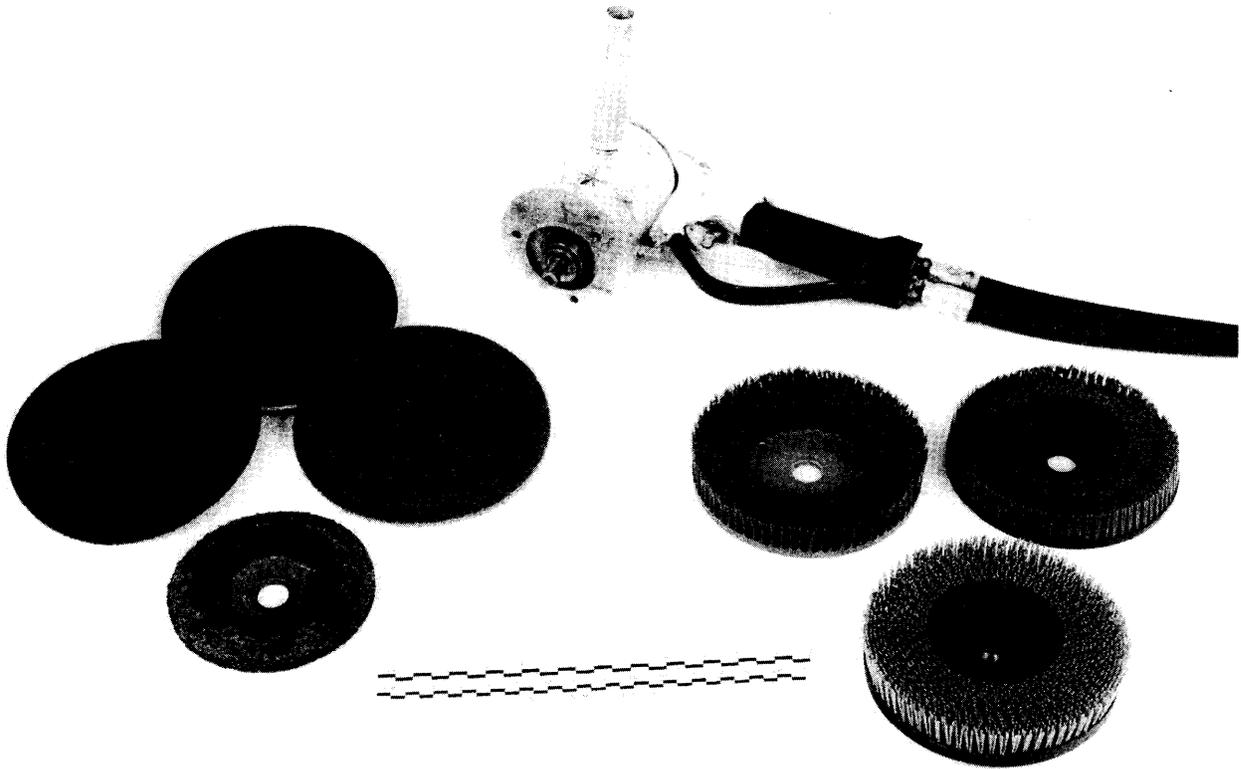


Figure 1. Powered abrasive discs and brushes.



Figure 2. Whirl Away rotary abrading tool.

MANUFACTURERS: Stanley Hydraulic Tools
3810 SE Naef Rd
Milwaukie, OR 97222
Tel 503-659-5660

R. C. Collins, Inc.
746 NE 67 St
Miami, FL 33138
Tel 305-751-0676

3M Company
Industrial Trades Building Service
and Cleaning Products Division
St. Paul, MN 55144

AB Tex Corporation
Rochester, NY

ENVIRONMENTAL CONSIDERATIONS: Cleaning operations with the equipment discussed in this Technical Note may increase the level of suspended and soluble materials in the water column adjacent to and downstream from the operation. Whether these increases will result in unacceptable water quality or other undesirable environmental consequences should be evaluated on a project-specific basis. Variables that influence the nature and magnitude of any impacts include, but may not be limited to: the hydrodynamic setting, the physical and chemical characteristics of the sediment or residue generated during the cleaning or dredging process, and the regulatory environment. Personnel familiar with evaluating water quality impacts of construction operations should be consulted during the early stages of project planning to ensure that appropriate water quality criteria and other environmental regulations will be met.

REFERENCES:

- a. Evaluation of underwater propeller cleaning equipment and techniques for removal of calcareous marine growth. D. B. Wyman, M. L. Pemberton. NCSC TM 376-83, Aug 1983.
- b. Procedures and devices for underwater cleaning of civil work structures. C. A. Keeney, Naval Civil Engineering Laboratory, Port Hueneme, CA. Prepared for US Army Engineer Waterways Experiment Station, Vicksburg, MS. Technical Report REMR-CS-8 (in preparation).