Power Tool Cleaning

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Surface preparation is the most important factor in protective coating applications. To achieve a properly prepared surface using power tools, extreme care must be taken in choosing the proper tool and abrasive. Failure to do so could result in excessive costs for labor or material disposal. Because of the hazards associated with lead paint removal and disposal of contaminated coatings, vacuum-assisted power tools are often found to be a very economic option over blasting and other popular surface preparation methods.

Common Surface Preparation Problems

Flaking, bubbling, blistering, and chipping are some of the most common signs of coating failure resulting from poor surface preparation. The most common cause of blistering or bubbling is contamination of a surface before coating application. There are two forms of contamination: visible and non-visible. The most common form of visible contamination is a corrosion byproduct—rust. The most serious form of non-visible contaminants are soluble salts. Because of their ability to draw in moisture from the coated surface, it is imperative to check for their presence before the application of a new coating; failure to do so will result in costly corrosion problems down the road.

Another cause of poor coating adhesion is poor surface profile. Surface profile is the measurement of the roughness of a surface. Although often overlooked, profiling a surface is critical, as it provides the "anchor" pattern necessary for proper adhesion and bonding of most coatings.

Three Basic Forms of Power Tools

Although power tools come in a variety of shapes and sizes, they can be broken down into three basic categories.

- Reciprocating impact tools
- Rotary impact / scarifying tools
- Grinders and sanders

Because of their higher productivity compared to reciprocating impact tools and grinders, rotary impact tools typically are the best choice for removing coatings. For spots that are difficult to reach and areas not accessible to rotary impact tools, needle scalers can be used. In short, an operator can look at rotary scarifiers as the "paint roller" and "reciprocating impact tools" as the paint brush. Like paint rollers, rotary scarifiers are used for the larger more accessible areas, whereas reciprocating impact tools, like paint brushes, are used for detail work such as reaching into corners and hard-to-reach areas. On average, one can expect a rotary impact tool productivity to be at least 5 to 7 times greater than productivity of a needle scaler for most applications.

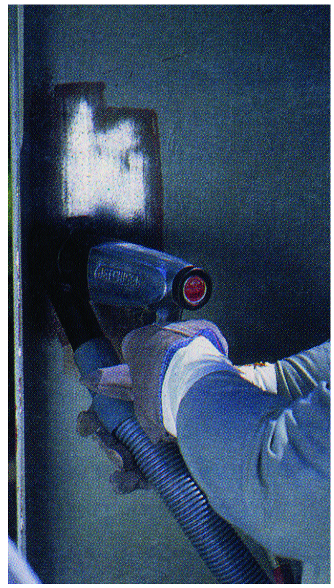

Fig.1: Needle scaler with dust collector attachment Photos courtesy of DESCO Mfg., Co., Inc.

Furthermore, for removal of hazardous coatings or other contaminated materials, impact and rotary impact tools will usually generate the lowest levels of airborne contamination. The chipping action of these tools when removing coatings and other unwanted material typically produces larger and heavier waste, which is easily contained. On the other hand, sanders and grinders remove coatings typically producing very fine, dust-like material. Because of the high revolutions per minute (rpm) generated by most grinders and sanders, the dust-like material generated, combined with the velocity of the particulate, can create containment problems if tools are not properly shrouded and operated.

All of the above tool groups are available in portable, hand-held, and walk-behind configurations. Most hand-held power tools are available in both electric as well as pneumatic (air) power. Electrical hand-held units typically require a standard 110 volts, while pneumatic units require 5 to 40 cfm of air (at 90 psi), depending on the tool. Reciprocating tools require the least amount of air supply, while larger sanders or rotary scarifiers consume the most air.

Larger walk-behind machines are available in electric, pneumatic, gas, and propane power. Electric machines usually require a higher voltage of 440 volts (three-phase power). Some smaller walk-behind units are available in 110 volt versions; however, because of the power required to drive the abrasive media, most units will have larger motors, requiring three-phase power. Depending on the size, most pneumatic units will require a minimum of 95 to 125 cfm, when operated at 90 psi.

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Reciprocating Impact Tools

Examples of reciprocating impact tools include needle scalers, chipping guns, and scabblers. These tools are most commonly characterized by an air-driven chisel or piston designed to strike surfaces. The chisels and pistons come in a variety of shapes and sizes to adapt to varying applications. Needle scalers are typically used for cleaning small areas or areas that are not accessible to rotary impact equipment because of limited clearance. Scabblers tend to be much more aggressive and are used for breaking up heavy rust, mill scale, coatings, or concrete. When using impact tools, an operator must take extreme care to avoid gouging or destroying the substrate.

Rotary Impact and Scarifying Tools

Rotary impact tools are characterized by any of a variety of rotating abrasive heads. Common forms of abrasive media used on rotary tools include, but are not limited to, roto-peen, roto-hammers, cutters, and nylon non-woven abrasive wheels.

Depending on the application, an operator may use one or a combination of abrasive media. An operator using a rotary impact or scarifying tool can do delicate work—such as removing paint from wood door casings—and heavy-duty work, such as removing coatings while imparting a profile on steel or grinding concrete. The best choice in abrasives will be dictated by the substrate involved, the material being removed, and the level of cleanliness required. Although an operator has more control over the finished produced with rotary tools, caution should still be exercised when using certain abrasive materials to avoid damaging the substrate.

Sanders and Grinders

Sanders and grinders come in a variety of shapes and sizes. Smaller mini-grinders allow operators to perform detailed work in difficult to reach areas, whereas larger sanders can be used for heavier grinding and production work. The four primary abrasives used with these tools are coated abrasives, non-woven abrasives, wire brushes, and diamond. Although wire brushes can remove coatings and loose mill scale, they will not completely remove rust. Wire brushes have a tendency to burnish or polish the rust, eventually resulting in rust-back and coating failure. Depending upon the disc, coated abrasives can be used for removing paint, mill scale and grinding rust. Unfortunately, coated abrasives do have a tendency to load or clog up, requiring frequent change outs, and they can damage a substrate if not used properly. Non-woven discs can be used effectively for scuffing and feathering paint, as well as removing rust and corrosion from steel substrates. Because of their design, non-woven discs will not load up like a coated abrasive disc and will not provide more constant performance throughout the life of the disc. Diamond abrasives are very effective for grinding and finishing concrete.

The Right Tool for the Right Job

When choosing the best-suited power tool for any given job, certain factors should be considered: the level of cleanliness required, the coatings to be removed, and environmental concerns.

Level of Cleanliness Required

Depending on the coating to be applied and the level of cleanliness it requires, most contracts that call for power tool cleaning will require a contractor to meet an SSPC-SP 3 (Power Tool Cleaning) or SSPC-SP 11 (Power Tool Cleaning to Bare Metal) level of cleanliness. With some projects, such as bridge repainting, it is not uncommon to see SSPC-SP 3 specified on some areas and SSPC-SP 11 on others.

The major difference between SSPC-SP 3 and SSPC-SP 11 is the level of cleanliness required. SSPC-SP 3 essentially requires the surface be free of any loose mill scale, rust, paint, or other foreign matter and is typically specified for coatings requiring minimal surface cleanliness before recoating. For those coatings requiring much higher levels of cleanliness, SSPC-SP 11 is specified. When viewed without magnification, the surface is to be "free of all visible oil, grease, dirt, dust, mill scale, rust, paint, oxide, corrosion products, and other foreign matter." SSPC-SP 11 also requires the contractor impart a minimum profile of 1 mil (25 micrometers) to provide an anchor pattern for the new coating system.

A critical point to remember when preparing any surface area to a SSPC-SP 11 finish is that the level of cleanliness acceptable is never the same in all cases. What is acceptable will depend on the original state of the steel substrate before initial coating application. A level of cleanliness acceptable on one project may not be acceptable on another. For example, if the coating being removed was initially applied to a fresh, blast-cleaned steel substrate, the level of cleanliness required is different from that for a substrate with heavy pitting and mill scale. To determine what is acceptable, SSPC has developed visual standards that provide pictures of acceptable levels of cleanliness under SSPC-SP 11. Unfortunately not all inspectors are aware of the different visual standards and subsequently, may demand levels of cleanliness higher than what is actually required by SSPC-SP 11. Therefore, it is highly recommended that contractors have a copy of the visual standard on hand and prepare a test patch to be approved by the project inspector.

Coatings To Be Removed

Reciprocating or rotary impact tools are most often the best choice for removing coatings. Typically, rotary impact tools are used for the bulk of the work, while impact tools such as needle scalers and

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chisels are used for detailed areas not accessible to the rotary impact tools. In addition to being faster, rotary impact tools can create a profile on the steel which will allow the coatings to adhere. Sanders are typically used for removing residual surface contaminants, feathering edges, and repairing spot failures.

Rotary impact tools outfitted with roto peen abrasive hubs are often the first choice for removing fracturable coatings, such as epoxies up to 15 mils (375 micrometers) thick. An operator can expect to remove the majority of a coating, while leaving a 1 to 3 mil (25 to 75 micrometer) surface profile. Care must be taken not to run roto peen over protruding objects or off the edge of a substrate. Doing so will result in damage to the abrasive. It is critical that operators use roto peen at the appropriate height adjustment and rpm. Failure to do so will result in significant reduction in life and damage to the abrasive. When used properly, roto peen can last 60 hours or more; when used improperly, the abrasive can be destroyed in minutes. When red lead is present in the paint, residual primer is often left in the pits of the substrate. If SSPC-SP 11 is required, a secondary operation using a non-woven abrasive may be necessary to remove the residual primer.

For heavy fracturable coatings thicker than 15 mils (375 micrometers), roto hammers are most effective. Because of their design, roto hammers are very effective on irregular surfaces or on substrates with protruding objects such as bolt heads, rivet heads, or weld beads. Unlike roto peen or cutters, roto hammers will conform to the surface and are therefore less likely to cause damage or be damaged from such protruding objects. Because roto hammers produce a limited profile, roto peening will be necessary to produce the profile required by SSPC-SP 11.

For heavy non-fracturable coatings, rotary scarifiers with cutters and reciprocating impact tools with chisels or

Fig. 2: Rotary impact tool in use on vertical surface, with dust collector attachment

scrapers offer the best method of coating removal. Rotary scarifiers with cutters or chisels and scrapers basically cut or shear the coating from the substrate. Certain urethanes and other coatings are so soft and flexible that roto peen, roto hammers, and needle scarifiers will do little more than bounce off the coating surface. With some coatings, such as self-leveling/cementitious coating systems used on concrete floors, the best method for removal is often through chipping hammers, scabblers, or scarifiers. The primary objective with these applications is again to shear or cut the coating from substrate surface.

Projects do not always require complete coating removal. Many applications simply require a contractor to scuff and feather coatings or remove loose coatings before applying a fresh coat of paint. Sanders outfitted with a variety of abrasives most often are the best choice for this type of surface preparation, as they are well suited for removing rust and corrosion and other surface contaminants. Wire cup wheels are often used for removing loose coatings from substrates. Unfortunately, because of their tendency to burnish a surface, the level of cleanliness and finish is not suitable for many types of coatings systems. Nylon non-woven abrasives are excellent for scuffing and feathering coatings while resisting the loading factor experienced with most coated abrasive products. Other specialty non-woven discs are excellent for cleaning to Near-White metal (SSPC-SP 10/NACE No. 2) or Very Thorough (Sa 2½). They remove rust, corrosion, and other surface contaminants without damaging the substrate. Because of their design, they are often used as a secondary operation for removing trace coatings and contamination without destroying the profile earlier imparted through roto peen applications.

Environmental Concerns

Vacuum-assisted power tools provide an excellent option for removing hazardous coatings or in removing coatings in environments where nuisance dust is a concern. When used properly, vacuum-assisted power tools are capable of grinding, cleaning, peening, or scarifying in a virtually dust-free environment. When choosing a system, you must ensure that the vacuum used is appropriate for the application. A tool capable of operating well below the allowable level of airborne dust when 25 ft (8 m) from a given vacuum source may emit airborne dust at very high levels when operated 50 ft (15 m) from the same vacuum source.

Not all vacuum-assisted power tools are the same. Some offer very high levels of containment; others provide minor dust control at best. The factors affecting the efficiency of a vacuum-assisted power tool include the type of tool being used (i.e., impact tool, rotary scarifier, or grinder), the design of the dust collector attachment, and the vacuum system. Due to the volume of dust produced and rpm generated by sanders and grinders, these tools typically require more sophisticated dust collector attachments as well as more powerful vacuums to achieve the same levels of containment as impact and rotary impact tools. Be sure the vacuum is in good working order and has been properly maintained. A dirty bag or filter can significantly affect a vacuum's performance, resulting in failure of the containment system. Last, verify that the vacuum performance specifications meet the minimal requirements for the power tools being used.

Maintaining and Servicing Equipment

The biggest contributors to pneumatic tool failure is poor air supply and poor air quality. Tools must receive the appropriate amount of air to operate the equipment properly, and it is critical to make sure that the air is clean, dry, and receiving the appropriate amount of lubrication. Air hose assemblies with a built-in filter / evaporator and lubricator are often provided with the equipment. To ensure maximum performance and tool life, these assemblies should be used at all times. For best performance, an in-line dryer should be installed at the compressor to remove condensation that naturally occurs in the lines.

For maximum performance and longevity from power surface preparation tools, set up a periodic maintenance and servicing program. During maintenance intervals, tools should be lubricated with oil. They should also be taken apart and the bearings should be greased (where applicable) and inspected for wear in such areas as bushings, bearings, air motor veins, and other areas as recommended by the manufacturer. Proper maintenance will prevent costly repairs in the future.

Safety

When working with any type of tool that has moving parts, proper safety precautions must be taken to prevent operator injury. Generally recognized safety guidelines for use of power surface preparation tools include the following.

- Always wear eye protection to protect eyes from airborne debris.
- Always wear hearing protection. Many power tools emit levels of noise that can result in permanent hearing loss. (See manufacturer's tool specifications for decibel [dB] levels.)
- Have an electrician check all electrical machinery and cords before use.
- Check all air hoses for cracks or frays.
- Keep air hoses or electrical cords clear of machine head.
- Disconnect equipment from its power supply before changing an abrasive hub or working on the equipment.
- When removing hazardous coatings, verify that the vacuum used is appropriate for the tool being used and for the distance of the tool from the vacuum source.
- When removing hazardous coatings, always consult a safety officer to ensure proper equipment set-up as well as worker and environmental protection. See the relevant safety regulations for hazardous coating removal.

Conclusion

Surface preparation is a multi-faceted process. When selecting a tool for a job, take into account the coatings being removed; the surface to be prepared; the level of cleanliness required; and most importantly, the protection of the worker and the environment. By taking these factors into consideration, an operator will have the necessary information to make the best choice in selecting the appropriate tool and abrasive for each application. Selecting the proper equipment will enable an operator to save time and money while achieving maximum performance from the new coating system.