PLASTIC MEDIA BLASTING

Plastic media blasting (PMB) is a process for the rapid, economic and safe removal of coatings from almost any product. Although resembling sandblasting, PMB does not use hard abrasives such as silica sand. Rather, the process uses recyclable plastic particles that are pneumatically applied at low pressure of 20-40 psi. The plastic particles vary in hardness from 3.0-4.0 Mohs compared with hard abrasives that are in the 7-Mohs range.

Because the plastic granules are harder than coatings but softer than underlying substrates, PMB can quickly remove primers and top coats without harming sensitive substrates, such as aluminium, brass, copper, magnesium, thin steel and titanium. Additionally the process can be utilised on surfaces where chemical stripping cannot be used or must be applied with caution, such as panels of honeycomb construction, engineered plastic, fibreglass and advanced composites.

Plastic media blasting technology has been in use for over six years, principally for the stripping of aircraft and aerospace components; however, with the increase in environmental awareness and stricter environmental regulations, the process has matured into a distinct technology, applicable to the depainting requirements of a broad range of industries.

ENVIRONMENTAL REWARDS

Use of PMB was originally fostered by the US, Department of Defense to replace the toxic chemical strippers previously used for the stripping of strategic military aircraft and aerospace components. The major factor that gave impetus of the process was the promulgation by the Environmental Protection Agency (EPA) of it's final rule that absolutely prohibits the disposal of certain chemical solvents in landfills throughout the United States, including the most effective chemical strippers containing methylene chloride or phenols.

An alternative disposal method for these solvents is incineration, with the cost of disposal for a 55-gal drum of such chemical effluents ranging up to £600-£700.

OTHER BENEFITS.

In addition to its environmental rewards, PMB offered significant economic benefits. With up to 90% reduction in labour requirements, PMB can result in saving of both labour and downtime. Unlike chemical strippers, PMB is an all-weather stripping method. Cool temperatures, which can render stripping chemicals almost inert, have no effect on the PMB process; likewise, warmer temperatures, which cause rapid drying of chemical stripper films before they have completed their work, have no effect on PMB. The PMB process does not etch, warp, stretch or remove metal resulting in a stripped surface without compromising critical surface or mechanical dimensions. This results in longer equipment service life and virtually eliminates the need for filling primers to achieve a smooth finish. The use of PMB also reduces the extensive masking normally required prior to chemical stripping or sandblasting. The use of PMB does not harm bearings, seals or many other components that could otherwise be damaged by the more commonly used stripping methods.

The PMB process has other interesting aspects. With the new types of media now available, it is often possible to remove coatings one layer at a time, leaving primer or surface fillers substantially intact. Likewise conversion coatings can be left intact, eliminating the need for costly chemical reprocessing.

TRADITIONAL APPLICATIONS FOR PLASTIC MEDIA BLASTING

Initially, it was though that the major market for PMB would be in the aircraft industry. An early concern with regard to the use of PMB, particularly the US. Air Force, was the question of substrate damage during the removal of coatings from aircraft airframes and aerospace components. The major cause of concern may be summarised as follows: (1) removal of cladding on alclad aluminium; (2) masking of fatigue cracks occasioned by the movement of cladding sufficient to cover cracks; (3) crack initiation caused by the presence, in the blast media, of high-density particles (such as foreign metal and silica sand); (4) fatigue life reduction; and (5) damage to resin-starved composites (e.g aramid and carbon fiber composites). By reason of extensive testing of PMB by various military agencies and their consultants, coupled with the introduction of equipment enhancements (such as improved media reclamation systems and high-density particle contamination separation systems) and new types of blast media, the subject concerns have been substantially reduced or resolved.

The Federal Aviation Administration is in the process of approving PMB use on a case-by-case basis: however, with new advances in blast media and in equipment, it is expected that within several years, PMB will be widely used for the stripping of most general aviation airframes.

NEW APPLICATIONS FOR PLASTIC MEDIA BLASTING

The applications for PMB are limited only by the imagination, and the worldwide potential for the process is vast. Potential applications include, but are not limited to, the dry stripping or cleaning (1) of industrial machinery, equipment, dies, molds, engines and other products, especially where critical surface of mechanical dimensions cannot be compromised; (2) the exteriors of aluminium, steel, fibreglass and plastic tanks, totes and other containers; (3) the interiors of aluminium and stainless steel tank trailers, tank trucks and intermodal containers, especially where tenacious hard, dry coatings, such as latex and diisocyonates must be removed; (4) ground transportation vehicles, including automobiles, tractors, trailers and trucks whether fabricated of aluminium steel or fibreglass: (5) aerospace ground support equipment and weapons systems: (6) new fibreglass and plastic panel parts to ensure paint bonding; (7) marine vessel hull and related components; (8) an endless range of consumer household products, such as garden furniture, interior cabinets, floors, walls, pool tiles and other household items.

The PMB process can be used to remove virtually any primer, paint or surface coating, including urethanes, chemically resistant coatings, powder coatings and even carbon build-up.

CONSIDERATIONS FOR THE USE OF PLASTIC MEDIA BLASTING

Although the PMB process resembles sandblasting, the two processes have little in common. When sandblasting, silica sand or other hard abrasives are pneumatically conveyed at volumes of 450kg/hr and at pressures normally at 100 psi or more. The operator may be 3 or 4 ft from the surface of the work piece.

Most coatings are removed along with a portion of the base substrate to produce an anchor pattern or white metal finish prior to priming and painting. Often, substantial damage can be caused to thin metal or sensitive substrates. On the other hand, PMB can be used to remove virtually any coating from almost any substrate without damage.

When using this technology, there are certain variables that affect the viability of the process for any given application, including (1) blasting pressures (typically ranging from 20 to 40 psi. but may be as low as 5 psi and as high as 60 psi); (2) angle of blast nozzle to substrate; (3) media flow rates (typically ranging from 90/180kg/hr (1.5-3kg/min), with a ½-in nozzle; (4) blasting stand off distance of nozzle to work piece (typically from 6 to 18 in); (5) type of coatings to be removed; (6) nature of substrate material and thickness; (7) selection of blast media, including type and size; (8) determination of nozzle size; (9) masking requirements; and (10) types and capabilities of plastic media blasting systems currently available in the marketplace.

In actual practice, all of these variables are not constantly and separately considered during the course of the stripping process. Normally the PMB operator, who has had proper training and experience, will have predetermined the parameters to be applied to a given substrate. Further in the case of a complex work piece, such as an aircraft with a variety of substrates (such as magnesium, titanium, clad aluminium and composites), a "blast plan" can be prepared, marking each substrate as to type, prior to blasting.

In this connection, state of the art equipment now available can greatly facilitate the application for the PMB process. For example electric remote control right at the blast nozzle can adjust both blasting air pressure and media flows to accommodate the rapid transition from one substrate to another.

MEDIA

The plastic media industry has undergone tremendous change in recent years. When the US. military began utilising the PMB technology, only three types of plastic media were authorised Type I, polyester (thermoset): Type II, urea formaldehyde (thermoset); and Type III melamine formaldehyde (thermoset). By May of 1988, the Navy had approved two additional types of media per MIL-P-85891 (AS): Type IV, phenol formaldehyde (thermoset); and Type V, acrylic (thermoplastic).

In March 1990, the Navy promulgated a draft of a new specification, adding a sixth type of media per MIL-P-85891A-0386 DD, Type VI, poly allyl diglycol carbonate (thermoset). In April 1990, at the Department of Defense Advanced Coatings Removal Conference, a seventh type of media was introduced, Type VII, a biodegradable, nonpetroleum amylaceous polymer. The new Type VII media, a processed wheat starch product is very safe on sensitive substrates and appears to be effective on selected composite/coating combinations.

MEDIA SELECTION

Because one media for all combinations of coating and substrate is not going to be a reality on the foreseeable future, the problem of media selection is now with us. Figure 1 can serve as a guide in selecting media candidates for testing. The X axis shows grit from 60 (very fine) to 12 mesh (very coarse). On the Y axis, the types of media are shown (See Appendix 1). They are listed here in order of hardness:

Type I (polyester) is the softest plastic media and is rarely used today for paint removal. It is too slow. A frustrated operator has a tendency to dwell causing heat and damage to the substrate.

Type VI ("clear cut") is significantly more aggressive on coatings than Type I but is very safe on most substrata particularly composites. It has good removal rates when used on composites.

Type V (acrylic) has proved most popular on aluminium aircraft skins. It is less aggressive and has lower removal rates then Type II. It will not remove many primers.

Type II (urea) is the most heavily used of the PMB accounting for over 60% of today's media usage. It is used on a wide variety of soft metals, some composites and steel

Type III (melamine) is the hardest and most aggressive plastic media.

As one increases the grit size to harder media, the action on the coating and substrate is more aggressive. A very fine Type III can cause less damage to the substrate than a coarse Type II and still have as good or better removal rates. Selection strategies must consider both media type and grit size. In addition selection strategies must consider the action on both coating and substrate. For example, Type VI exhibits good removal rates (similar to Type II) on composites, yet is much kinder to the substrate compared with Type II.

USER RESPONSIBILITIES

Testing and selection is time-consuming expensive. Although the media manufacturer or distributor should be able to offer guidance, the final responsibility must be the user's. There are other user responsibilities, including the following (1) setting and controlling blast parameters; (2) controlling contamination of the media (including cleaning the blast object prior to putting it into the booth and cleaning the media during production through screening and, where necessary, heavy-particle separation; and (3) periodic replenishment of media to maintain a constant grit-size distribution.

With this background, the discussion of media problems, which originate with media manufacturer, will be more meaningful. Keep in mind, the following analysis presumes that the user has net all the listed responsibilities.

PROBLEMS RESULTING FROM POOR MEDIA

The problems resulting from poor media include pitting, warping, fatigue, low cutting rate, removal resistance, high media breakdown rate, dust, colour, static and contaminants.

Understand that the user must balance substrate damage and media consumption against removal rate. This is no easy task, but is required because the ideal media does not exist.

The first three problems - pitting, warping and metal fatigue - are normally caused by selecting the wrong media; however, scrap with heavy particulate contaminants can be a cause Even new, unused media can cause problems if high specific gravity fillers have been used. Barium sulphate or calcium carbonate have been used to increase the specific gravity in some compounds. Media manufactures from such compounds will not meet the military specifications for plastic media.

Often manufacturers buying new or scrap moulding compound do not know exactly what they are receiving. It is the manufacturers obligation to test and ensure users that they are getting material that meet military specification. It is particularly infuriating to the end user when product from the same manufacturer is variable from shipment to shipment and sometimes within a shipment. It is not unusual for an operator to find one shipment much more or less aggressive than another.

Problems of off-spec particle size distribution can also cause pitting. Remember, aggressiveness is a function of both media type and grit size. With the manufacturing systems now available, and with good inspection and testing procedures, availability of consistent, high-quality material should be expected by the buyer.

Experiencing low cutting rates on coatings resistant to removal may mean that a more aggressive media (type or grit size) is required. Of course, there is always a risk that the more aggressive media will damage the substrate. Again, a vexing problem to the user is an intermittent problem with the same media grade from the same manufacturer. There may be a problem with either the scrap or the virgin material. Poor cure and excessive flash on the moulded parts are likely culprits.

The media manufacturer can avoid some of these problems by thoroughly hardness testing the moulded parts prior to grinding and classifying. This testing must be both on the surface and in the centre of the moulded part, because variability in the moulding compounds is difficult to predict, and the resultant effect on blasting is not always obvious.

High breakdown rates can be due to the media selected for the application. If the problem is intermittent it may be caused by the manufacturer. Again, constant testing by the media manufacturer is imperative to determine that the moulded parts are well cured and the product has met quality-control tests.

Excessive dust is a result of poorly moulded parts, faulty compound or poor classifying. Colour does not affect the characteristics of blasting media except in the case of black, which seems to break down faster; however, users occasionally correlate media performance with visual identification, including colour. Many media faults are visually detectable, whereas other are not.

Static is a growing problem as new, longer media are developed. Type V (acrylic), Type VI (clear cut), and Type I (polyester) are particularly susceptible to static after continued use. The problem can be solved through addition of anti static agents. Blasting equipment modifications such as humidifiers and grounded hoses, are also very helpful.

Contaminants, such as chemicals and metal particles, are attributable to scrap parts. The chemicals, such as cadmium, arsenic and lead are no longer used in the United States in manufacture of pigments; however, old parts such as buttons from the mid-1970s or earlier as well as imported scrap can still have these present.

Another contaminate, sometimes known as "fuzz balls" is actually ground paper that has picked up fine particles and dust. These may come from scrap parts with labels or decals. Paper washers in electrical connectors also cause the problem. Media manufacturers can take preventive measures to see that these contaminants never reach the finished drums of media.

A significant problem that is a result of inconsistent media is setting an operational specification for the blasters. Even if the media is clean and well manufactured, the variability in the compound itself can cause variation to the operator. As the operators get more sophisticated, learning how to do the job better, these problems become more apparent. When applying robotics, inconsistent media adds another level of complication.

You will not be able to get a "grooved swing" until you have custom media engineered from the compound to the delivered product. You need custom product that will eventually be near optimum and have none of the problems discussed herein.

CUSTOM MEDIA

Custom media has the following characteristics; custom-made compound, standardised moulding environment; standardised grinding; classifying within specification; consistent anti static properties. What is meant by "custom" media? First, consider the compound. Thermoset moulding compounds have never been developed specifically for this industry. They have been developed for moulding dinnerware or bottle caps with smooth hard surfaces and they have been developed for electrical connectors, wall plates or buttons. A PMB product should be optimised for high-speed cutting, low breakdown and minimum damage to the substrata. Such compounds should also have consistent granularity, colour and mould ability.

EQUIPMENT ENHANCEMENTS

The original PMB systems brought to the marketplace were little more than sandblast pressure vessels, modified with 60° cone bottoms to accommodate the flow characteristics of the plastic blast media. Media reclaim systems were typically of the type used for steel-shot reclaiming, resulting in tremendous recovering capability but lacking in ability to properly clean the low-density plastic media.

Certain PMB systems today offer many features not even considered a few years ago, Media reclaim systems on some machines now utilise true cyclone separators with low-hp fan/motors to efficiently remove substantially all coating residue and plastic fines from the recyclable plastic media. This permits the recovery and reuse of the media, of ten for up to 30 cycles or more, resulting in media consumption rates as low as 4kg per blast hour. Large-area magnetic separators for the removal of ferrous particle contamination are now available and several PMB systems on the market now utilise compact and highly efficient cartridge of even sub micron particles from the dust collector exhaust air.

One system offered the ability to remotely control blasting air pressure and media flow at the blast nozzle, allowing quick transition from one substrate to another e.g from steel to aluminium to fibreglass (on automobiles) or from magnesium to titanium to clad or anodised aluminium to advanced composites (on aircraft airframes). This feature is invaluable for the stripping of expensive, complex components, thin metals or advance composites

Some PMB systems now provide nozzle-mounted. quartz halogen blast lamps for increased illumination of the work piece. With the blast lamp mounted on the nozzle, an operator is not required to work in his own shadow and can maintain the high degree of lighting required when working on sensitive substrates, such as fibreglass and composites. Advanced PMB cabinets (glove boxes) are available with operator controls to rapidly adjust blast air pressure and media flow to accommodate sensitive substrates. There are now conversion kits to retrofit both existing "open blasting" PMB systems and PMB blast cabinets with operator remote controls for adjustment of blast air pressure and media flow.

Low-cost PMB blast rooms are now manufactured of 18-gauge sheet metal rather than the 10-12 gauge steel plate typical of sandblast booths. Because the PMB process doe not remove metal, such economical rooms are entirely satisfactory.

New, advanced and highly efficient dust collectors to provide ventilation for blast rooms are now available. Certain compact, energy efficient, modular systems how on the market provide automatic reverse pulse-jet cleaning on demand, with each module having a capacity of from 6,000 to 16,000 cfm. One or more of these modules can supply linear air flows of from 37½ fpm to over 100 fpm, meeting the most stringent requirements of the US. military and other regulatory authorities.

Such systems can also be configured as mobile units to provide negative pressure in temporary structures at remote sites, for example, high-density particle separation (HDPS) systems to remove heavy particles, such as silica sand from otherwise recyclable plastic blast media. Although this is not a major concern for many stripping applications, the military and aerospace communities are very conscious of the damage that could be occasioned by this type of contamination. Current military specifications require that media having a contamination level of

0.02% by weight (200ppm) be taken out of service until it can be effectively cleaned. Airflame manufacturers require that the plastic media be free of contaminants to within 0.03%.

Low profile HDPS equipment is now on the market, either as on-line or off-line systems that exceed the requirements of the US. military and airflame manufacturers.

PLASTIC MEDIA BLASTING OPERATING COSTS

The variable out-of-pocket costs (i.e., excluding allocation of fixed expenses) of the PMB process per blast hour can fluctuate depending on a number of factors including (1) the hourly cost of direct labour personnel; (2) labour productivity rates (typically 75%); (3) the cost of blast media may range from£2.90-£3.50, depending of the type of media and purchase quantities; (4) energy consumption costs; (5) overhead cost - principally masking supplies and indirect labour; (6) waste disposal costs can range from inconsequential up to $4 per blast hour is hazardous waster is generated by the PMB process (assuming the use of ½-in blast nozzle); (7) removal rate- depending upon the nature of the coatings being removed and the type of target substrate - can range from 0.5 fpm or over 4 fpm (assuming the use of a ½-in nozzle at 30 psi); and (8) the efficiency of the media reclamation system - with a high efficiency reclamation system capable of separating substantially all paint dust and media fines from the recyclable media, the blast media can be recycled up to 30 cycles and can effectively remove coatings even where such media has been broken down from a 12 to a 60 US mesh size. With such a system consumption rates can be as low as 4.5kgs per blast hour (using a ½-in nozzle at 30 psi).

Because of these factors, variable operating costs per blast hour can be a little as £28/£29 to as high as £45 and the cost for the removal per square foot can range from as low as £0.20 to as high as £1.50 where tenacious coatings must be removed from sensitive substrates that require extensive masking. Typically, the cost should not exceed £0.45 per square foot.

NB All £ Sterling calculations based on £:$1.58