Offshore Oil Platform Surface Preparation Using the Pliant Media Blasting Technology

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From: Increasing the Value of Coatings; The Proceedings from the 1999 Seminars
Orlando, FL November 14-18, 1999

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OFFSHORE OIL PLATFORM SURFACE PREPARATION USING THE PLIANT MEDIA BLASTING TECHNOLOGY

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ABSTRACT: Pliant abrasive media is transforming the way coating maintenance personnel approach offshore surface preparation. Pliant media users are often able to lower total job costs and provide higher quality surface preparation.

OVERVIEW OF OFFSHORE MAINTENANCE

Millions of dollars are being allocated toward the maintenance of offshore platforms with the goal to maximize oil production operations. A modern offshore platform extracting 40,000 barrels of crude oil per day at $18 per barrel could return nearly $720,000 a day. The opportunity costs during equipment failure or production shutdowns are large. Thus, platform owners expect innovative maintenance specialists to utilize maintenance solutions that minimize the adverse effects on production operations. Additionally, owners require performance within time, budgetary and space constraints common to offshore platform environments.

As a result, maintenance professionals must carefully select appropriate products and technologies. Few new products have had the impact of pliant abrasive media. Pliant media has the significant ability to allow top quality surface preparation in close proximity to operating production equipment.

An increasing emphasis on offshore preventative maintenance has led to scheduled coating maintenance long before total coating failure. Many offshore coating maintenance professionals start coating maintenance when only 3% to 6% of the coating is failing. This practice minimizes corrosion and minimizes the scale of operations required to restore the coating's effectiveness – ultimately lowering the total life-cycle cost and the potential for future interruption to oil producing operations.

Offshore Surface Preparation: Historically, painting contractors and offshore maintenance consultants have considered media cost and cut rates as key cost determinants. Conventional abrasives all offer similar cut rates and profiles with similar characteristics regarding freight, dust, rebound and waste. Except for price per pound and cut rate, no conventional abrasive material offered any exceptional benefit versus another that could be calculated into a given project. Therefore, cut rate and price per pound drove the choice to use one conventional abrasive over another, and project estimate calculations tended to over-emphasize these elements.

With the development of innovative abrasive blasting technologies, a variety of new, meaningful, value-oriented choices have become available. Considerations like media handling, freight costs, process cleanliness, personnel safety, containment costs, consumption rates and disposal costs are increasingly driving the decision to utilize one technology instead of another.

Offshore coating professionals are beginning to consider the value of each benefit, even if they have an indirect effect on the total cost of the job. In many cases price per pound and cut rates have become secondary – especially when the benefits associated with new technologies offer higher overall cost savings. Abrasives like sodium bicarbonate (soda) have, for nearly a decade, enjoyed a leading role on offshore platforms among the new abrasive blasting technologies. In recent years, pliant media has been found to match soda as a useful tool as well.

Pliant media can be defined as dual component granules containing a pliant, sponge-like material and an abrasive, cutting particle. As dual component granules, pliant media offer certain benefits commonly associated with conventional abrasives as well as those associated with high-tech, low dust abrasive technologies. It is one of the few technologies that combine the best attributes of each category.

Pliant media technology is distinguished by its clean, dry, low dust, low rebound, reusable characteristics. It has been successfully used in offshore applications for the past three years. In addition to hands-on experience, both qualitative and quantitative data has been collected by operators, coating contractors and rig employees, revealing several important benefits.

Overblast: One of the key surface preparation problems on offshore platforms is overblasting. Unintentional blasting of a nearby area is usually caused by excessive media rebound. With overblasting, damage occurs to

Blasting near a "Pig Launcher" on this platform required little equipment wrapping and containment due to pliant media technology's low rebound and low dust attributes.

surrounding areas and to what may have been a stable coating system. For example, blasting operations in tight crevasses around overhead pipe racks, especially below the main decking, are conducive to overblast problems - since these areas are often hard to see during blasting and are hard to shield. If overblasting unintentionally removes existing coating systems, and these areas pass undetected, managers responsible for the coating project can be haunted with unscheduled and unbudgeted maintenance visits. Thus, the costs associated with the failure to control overblasting can extend well into the future - long after the job has ended. As a result, offshore maintenance managers and supervisors are continuously searching for new technologies that limit overblasting.

There are a number of alternative surface preparation technologies, but only a few are able to cut effectively and minimize media rebound associated with overblasting. Pliant media has been found to be effective at lowering overblast problems because of the energy absorbent physical and structural characteristics of its sponge-like component. It is also an efficient cutting technology partly because plaint media is manufactured to include such a wide range of traditional abrasive materials.

One reason pliant media limits rebound is that it hits the substrate traveling at lower velocities than do other abrasive blasting technologies. Conventional abrasive technologies typically achieve strike velocities close to 660 miles per hour (at 100 psi), while pliant media products effectively hit the surface at 340 miles per hour (at 80 psi) - both using a venturi blast nozzle[1].

Another reason why pliant media reduces rebound is because of its ability to absorb collision energy upon substrate impact. A discussion of elastic and inelastic forms of collision are useful to understand how pliant media lowers media rebound. Nearly all abrasive blasting technologies create tiny collisions, which form a series of either elastic or inelastic collisions. Inelastic collisions can be illustrated by throwing a beanbag against a wall and observing the result. Similar to what one would expect of the beanbag, at surface impact pliant media deforms, extending dwell time, dissipating potential rebound energy, flattening, exposing its abrasive components and contracting as it falls to the ground[2]. After leaving the substrate, theoretical calculations suggest pliant media velocities are reduced to 19 miles per hour, as compared to its initial strike velocity of 340 miles per hour[3]. Standard, crystalline-abrasive media, like silica sand or coal slag, form elastic collisions. Similar to a cue ball hitting another billiard ball, elastic collisions produce very little dwell time, dissipating little rebound energy on impact, and ricocheting in the manner one would expect a billiard ball to react when hit by the cue ball[4].

Observation, experience and theoretical calculations all suggest a significant reduction in over-blast with the use of pliant media. Pliant media's post-impact velocity was reduced by over 94%, supporting hands-on evidence of minimal damage to surrounding offshore coating systems[5]. On the other hand, conventional abrasives maintain higher post-impact velocities, which allow the abrasive material to damage surfaces not meant to be cut.[5]

Media Consumption: Media consumption is of great importance to offshore coating maintenance projects due to its direct impact on media handling, in and outbound freight costs, as well as on-shore disposal costs. As media consumption rates decrease, so do the costs associated with its handling, freight and disposal. Overall, pliant media users can expect to use less media than conventional abrasive media on same size projects.

Pliant media is designed and manufactured for reuse in sizes that allow for quick and efficient classification. With the use of modified sifting equipment, reusable pliant media can be efficiently separated from spent media, surface contaminants and failed coating particles. For instance, the particular pliant media used was prepared in sizes ranging from $^{1}/_{16}$ to $^{1}/_{4}$ inch diameters - or small enough to fit through a U.S. standard #3 sieve with a .279 inch square opening, but not to pass through a number #16 (.0445 inches). Conventional abrasives, like coal slag, are milled to much smaller sizes, as they can pass through standard #25 and #35 sieves (.0277 and .0176 inch openings). The size difference is a benefit to pliant media users because the large particle sizes are easily separated from smaller waste coating particles and the contaminants it removed on impact. For the purposes of offshore applications, pliant media can be effectively reused from five to six times using simple, portable classification equipment.

It is helpful to compare square foot consumption requirements of both conventional and pliant medias. Approximately eight pounds of pliant media are required to remove one square foot of a fully adhered, industrial epoxy coating system and to achieve an SP-10 “Near White Blast.” Approximately ten pounds of conventional abrasives are required to prepare the same surface, which is two pounds or 20% more than pliant media requirements. When blasting 200 square feet to the same specifications listed above, 1,600 pounds (200 sq. ft. × 8 lbs.) of pliant media is required, while it requires 2,000 (200 sq. ft. × 10 lbs.) pounds using conventional media to complete the same job. As we conservatively expect five reuses for every pound of blasted pliant media collected, we calculate a revised consumption rate. The total media requirement for the job, assuming five reuses, reduces from 1,600 to 320 pounds (refer to “A” in Figure 1). Conventional, free, hard abrasives, such as garnet and aluminum oxide, can be recycled, but usually the size and cost of the equipment required makes recycling impractical, especially offshore.

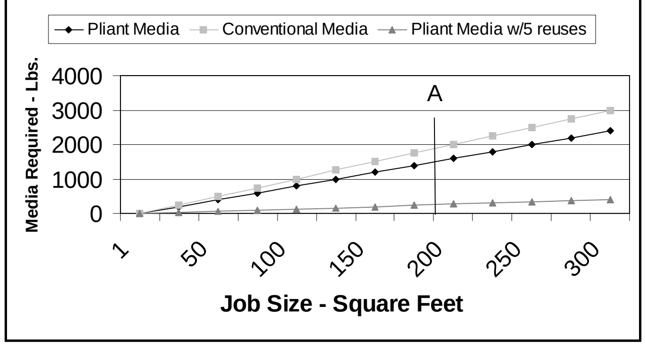


Figure 1 - Media Consumption

Virtually every offshore material requires transportation from an on-shore dock using a marine vessel or helicopter. Among the highest costs to consider when planning offshore coatings maintenance are the volume requirements of abrasive blasting media already mentioned, and the resources required to transport it. As media consumption rates decrease so should material handling costs, such as freight to and from the job-site.

Transportation costs can be considerable, given the usual transportation methods. Onshore transportation, using common motor freight carriers is billed by the pound and pallet. For example it costs approximately $122 to transport one 400-pound pallet of pliant media forty miles to a shipping dock. It costs $331 to transport one 2,000-pound pallet of conventional abrasives.

In addition to the lower shipping costs of transporting pliant media to dockside, lower marine transportation costs could be expected as well. Marine transportation costs are mainly billed by the day. There are three basic vessel types used to transport abrasive blasting materials. Crew boats, ranging from 80 to 110 feet long, are used to transport personnel and small volumes of material. Utility boats, ranging from 100 to 120 feet long, are used to transport moderate volumes of material. Supply boats, ranging from 150 to 180 feet long, transport larger volumes of material. It is standard in the industry to charge per day rates from $1,100 to $1,300, $1,400 to $1,700 and $2,200 to $2,700 respectively. Helicopters, used only during time-critical situations, also carry people and small cargo, but require flat fee rentals between $3,000 and $5,000 plus $350-550 per flight hour.

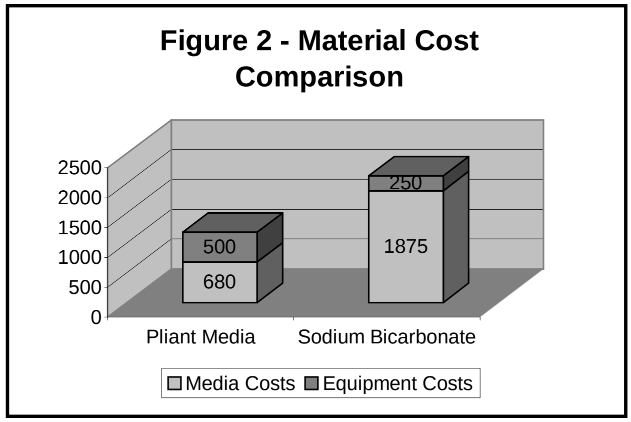
Conventional media, due to the large weight and volumes required, typically call for an independent vessel costing from $1,500 to $3,000. The lower weight and volume requirements of pliant media can typically fit on weekly grocery boats, which lead to significant cost savings.

Technology Comparison: When conducting moderate to small-scale offshore coating maintenance, sodium bicarbonate and pliant media blasting are the two technologies of choice. They both reduce media rebound, overblasting, and reduce damage to surrounding equipment. Surface preparation tests conducted on a Louisiana/Texas Gulf coast platform using both sodium bicarbonate and pliant media revealed pliant media is more cost effective, especially when comparing the cost for materials.

Five days of consumption data were collected by a project foreman. Only 400 pounds of pliant media were consumed, while, to blast the same square footage and substrate using sodium bicarbonate, 1,500 pounds were consumed. Comparisons showed that the pliant media costs totaled $680 (2 bags per day × $68 per bag × 5 days), while the costs for sodium bicarbonate where $1,875 (15 bags per day × $25 per bag × 5 days). Equipment rental costs were $500 and $250 per week respectively (refer to Figure 2- Material Cost Comparison).

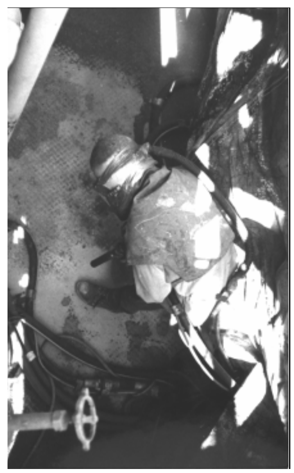
While pliant media equipment rental costs were double those of sodium bicarbonate, pliant media consumption accounted for less than a quarter of the sodium bicarbonate media costs. Combined, the material and equipment costs led to a savings of $875 using pliant media, which was 63% less than sodium bicarbonate costs.

Airborne Dust: In addition to the direct cost benefits regarding the use of pliant media, there are many indirect benefits. For example, pliant media users can expect improved visibility, better control of the area being prepared and the ability to conduct blasting in closer proximity to sensitive machinery. Although these benefits do not equate to directly measurable cost savings, they make surface preparation significantly easier on operators. They also allow for improvements in the quality of the



prepared surface, the total work environment and create less of an interference with nearby production processes.

As discussed earlier, pliant media particles flatten on surface impact, expose the cutting abrasive, work the failed coating and other surface contaminants loose, leaving the substrate with the specified profile. It reduces airborne dust in two ways. First, it flattens on impact, acting like a blanket, which inhibits the ricochet of the airborne paint and contaminants. Second, it traps paint and contaminants in its porous structure. The result is a significant reduction of airborne dust.



Note the clean, low dust environment enjoyed by this pliant media blaster on a checkered platform deck plate.

An airborne dust and contaminant study conducted by Jacques Whitford, Inc., a New England-based environmental engineering firm, measured amounts of airborne lead concentrations generated by pliant media blasting with the media produced by this company and conventional silica sand. Three two-hour blast periods were monitored for each blast process in an SSPC Class #3 negative pressure containment system. The blaster and an area monitor used NIOSH compliant air sampling pumps and filter cases. The tests, which are summarized below, compared abrasive blasting using sand and pliant media manufactured with #40 grit steel.

Subject	Pliant Media ($\mu g/m^3$)	Silica Sand ($\mu g/m^3$)	Lead Reduction ($\mu g/m^3$)
Blaster	4,990	69,800	64,810
Area Monitor	980	11,300	10,320

*Test processing by ESA Laboratories, Inc. Chelmsford, Massachusetts. $\mu g/m^3$ = Micrograms Per Cubic Meter

The results indicated levels of airborne contaminants were significantly lowered when blasting with pliant media. Airborne lead levels were reduced by 64,810 $\mu g/m^3$, or 92.8% at the blaster and 10,320 $\mu g/m^3$, or 91.3% in the containment area.[6] The implications on health and safety in an environment using pliant media are clear.

The improved visibility experienced by the pliant media blaster delivers an indirect benefit on its surface preparation quality. Conventional abrasive blasters have limited ability to view real-time blasting results due to the dust generated by the process, while pliant media blasters have better visibility, and therefore, better indication how their blasting is affecting the surface – at all times. Increased production rates can be expected, as there are fewer blasting stoppages taken to assess the progress and quality of the job. Better visibility also allows better control at the nozzle. Blasters, who are able to see the immediate effect of their nozzle movements, angles and distances from the substrate, are able to immediately adjust to problems.

With pliant media blasting, the ability to continue oil and gas production is critical to platform production operations. Pumping 1,666 barrels per hour, at $18 per barrel, interruptions could cost the owner $30,000 per hour when dusty surface preparation stops production. Damage to sensitive pumps, piping, gas generators and computerized production control systems happens most often when maintenance teams are abrasive blasting. The dust generated from conventional abrasive blasting tends to be a major cause of production equipment failure. During such failures, shut-ins occur, causing time consuming and costly production interruptions. The rule of thumb regarding production process failures is they require twice the time and the resources to repair when compared to onshore production lines. Pliant media's low dust and low rebound attributes tend to minimize impact on sensitive production processes.

The use of pliant media also allows deliberate blasting in close proximity to sensitive machinery. For example, there are a number of generators, pipeline pumps and gas compressors that are designed to rotate in different process configurations. These rotating mechanisms, often contaminated by dusty abrasive blasting, are less affected by pliant media blasting again due to its low dust and low rebound attributes. Process dust and ricochet, from conventional blasting, also tend to cause drainage clogs, pump malfunctions, or computerized system problems, which interrupt production and threaten productivity. These problems are drastically reduced with plaint media blasting.

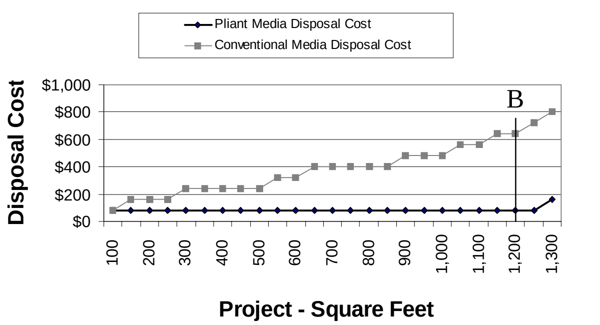
Surface Cleanliness: Lower quality levels of surface cleanliness after abrasive blasting often lead to additional, time consuming water-washing. Pliant media has been measured to clean at exceptionally high levels, in some cases without post-blast washing.

A.W. Chesterton, Inc., a worldwide industrial coating manufacturer and applicator, conducted blast tests using silica sand and this company's pliant media impregnated with aluminum oxide. Metal panels, which had been deliberately contaminated with sodium chloride to levels of 400 $\mu g/cm^2$, were blasted using both abrasives. Testing revealed the plates blasted with conventional abrasives required three washing cycles and one additional blast cycle to achieve chloride levels below 10 $\mu g/cm^2$, while the plate blasted using pliant media required no washing cycle, having already achieved residual chloride levels below 10 $\mu g/cm^2$. A.W. Chesterton then applied equivalent thicknesses of composite lining to both sets of panels, and subjected them to ATLAS Closed Cell Tests, per ATSM C868, using 50°C demineralized water. After six months the panels were inspected for blistering. Neither the conventionally blasted nor the pliant media blasted panels revealed coating failure[7], indicating with reasonable certainty, pliant media blasting can clean steel substrates to acceptable surface cleanliness without additional steps of water-washing.

Disposal of Pliant Media: There are many options regarding the disposal of spent pliant media. When disposing spent media and non-lead-based coatings, waste can be disposed in registered special waste or industrial landfills, similar to any other non-hazardous industrial waste product.

Costs of disposing waste in a special waste landfill are determined by minimum per ton fees, with the rough cost of $80 per ton plus a minimum gate rate, which can range from $200 to $300. Recall from the previous example the media volumes required to blast 200 square feet were 320 pounds of pliant media and 2,000 pounds of conventional sand, which are both under one ton, and the minimum gate fee would be the same for both waste products. The total disposal costs for both waste streams would be estimated at $330 (or $80 + 250). It is important to note on smaller projects, especially those that require the disposal of less than a ton of spent media and contaminants, disposal costs would remain the same. On larger projects, however, there can be a significant difference in disposal costs (refer to “B” in Figure 3).

Figure 3 - Cost Comparison for Industrial Waste Disposal



Note the incremental difference in disposal cost as project square footage increases. For example, waste generated from a 1,200 square foot project using conventional abrasives would cost $890 ($250 + (8 tons × $80), while the disposal costs using pliant media with the same square footage would cost $330 ($250 + $80), which would account for a 63% ($560) savings.

One additional benefit using pliant media is that the classification process effectively separates out fine particles from spent media in two separate spouts. At the end of a job, fine particles of spent pliant media, failed coating and contaminant particles are separable from good, reusable media. The reusable pliant media can be stored in barrels until it is needed again.

One-Step Dry Process: Pliant media blasting is a one-step, dry process. It does not utilize solvents, chemical thinners or other industrial cleaners to cut or clean a given surface. Pliant media is designed to hit the surface, flatten on impact, clean the contaminated surface, expose its abrasive, cut into the substrate, trap or inhibit dust generation – all in one step. Because pliant media is a dry process, it can be used near electrical conduit and sensitive computerized machinery.

Range of Abrasion: Pliant media is manufactured with a wide variety of abrasives. Steel grit, aluminum oxide, staurolite, plastic urea, glass beads and non-abrasive additives can be entrained in urethane to make pliant media. One pliant media manufacturer can demonstrate its pliant media system can be used as an industrial cleaner, and then, in as little as five minutes, be used to cut into the toughest industrial epoxy coating systems available. Additionally, pliant media is one of the few abrasive technologies that can be used to cut rubberized tank and railcar coatings. Pliant media, as a surface preparation and industrial tool, is perhaps the most versatile, low dust, technology available.

Containment: Shade cloths, wind screens, or polypropylene mesh screens are typically used as temporary containment walls in large open areas on offshore platforms. They allow blowing offshore winds to pass through them without ripping them from the platform. Their semi-transparent quality also allows moderate levels of daylight to pass through them.

The benefits of pliant media also allow for less sophisticated containment. The use of plywood along handrails and against production skids is sufficient to contain blasted pliant media in local areas – providing easy retrieval at the deck level. Ground cloths placed over grating decks is a good practice for containing blasted media from falling through grated openings on offshore platforms. Wrapping moderately sensitive equipment to protect it from over-blast is typically not necessary when pliant media blasting due to its lower ricochet.

Although less substantial containment structures are needed, they are still necessary – especially around pump air intakes.

The benefits of building less substantial containment combined with the time saved preparing production equipment from ricochet have a direct, beneficial effect on labor costs, although they are hard to calculate.

CONCLUSION

Pliant media is well suited for harsh offshore environments and is changing the way offshore coating professionals think about planning, estimating and conducting surface preparation. With the availability of this new surface preparation technology, it is now appropriate to consider the process benefits as they effect the entire maintenance project, their effect on oil production operations, in addition to simple production rates.

Pliant media technology's clean, dry, low dust, low rebound and reusable characteristics minimize over-blast, minimize damage to surrounding equipment, minimize waste and materials transportation - making it an excellent tool on offshore platforms.

FOOTNOTES

(1) Sponge-Jet, Inc., Portsmouth, NH, USA.

(2) Paul Hewitt, *Conceptual Physics* *(Canada: Little Brown & Company*, 1981). P. 109-110.

(3) Sponge-Jet, Inc., Portsmouth, NH, USA.

(4) Paul Hewitt, *Conceptual Physics* *(Canada: Little Brown & Company*, 1981). P. 109-110.

(5) Sponge-Jet, Inc., Portsmouth, NH, USA.

(6) Jacques Whitford, Inc., Freeport, Me.

(7) Arc, Division of Chesterton, Stonham, Ma.