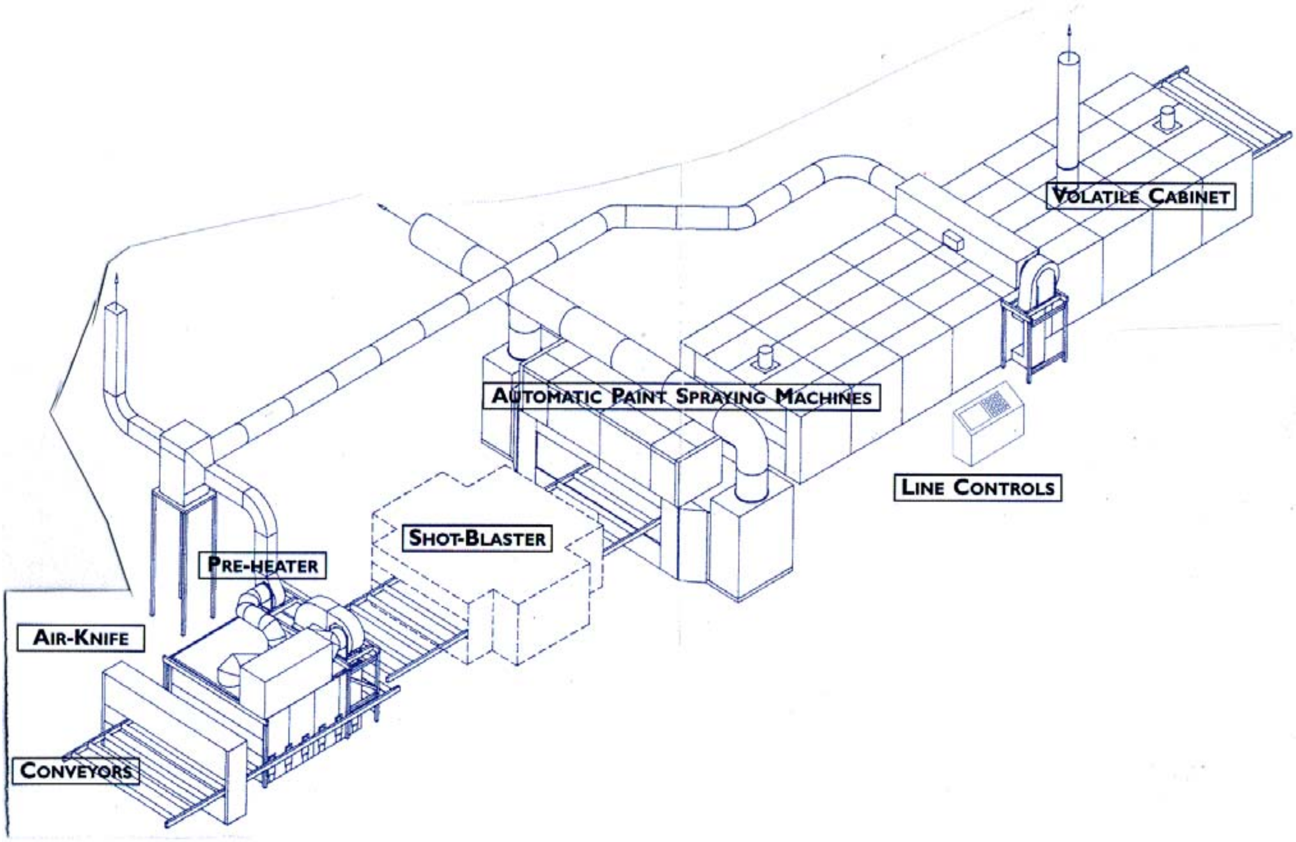
6. ROTARY OR WHEELABRATOR BLASTING

Rotary or wheelabrator blasting is an airless blasting process that cleans surfaces by throwing abrasive from impeller wheels or rotors. The plant used for this process is usually fixed, with blasting taking place in an enclosed environment. Apart from vacuum blasting machines, this equipment cannot be used for blasting ships in maintenance and repair situations. However, Wheelabrators are used by many newbuilding shipyards to blast steel plates, stiffening bars and pipes, in their own blasting and shop priming plants.

A typical impeller wheel would be about 50cm (20”) in diameter, 6½cm (2½”) wide and would rotate at 2000 rpm, giving average abrasive velocities in the same range as compressed air blasting units. However wheel blasting is far more efficient than air blasting because it only requires about one-tenth of the power to operate. For example, an average wheel installation would require 11-15kw (15-20 horsepower) to drive the machine and propel 10 tonnes of abrasive per hour. In comparison, air blasting would require 147kw (200 horsepower) and 5 x 9.5mm (5 x 3/8”) nozzles to propel half this amount of abrasive. Wheel blasting is therefore very efficient, production rates are fast, abrasive is always recycled, and because it is an automatic process there are few attendant labour costs. Unfortunately the lower costs are offset by the high initial cost of the plant and its large depreciation. The mechanical complexity of the machinery and high wear rates cause by the abrasive may also mean that high maintenance costs are incurred.

6.1 SHIPYARD BLASTING AND SHOP PRIMING PLANTS

During the course of your job, you may have to work in a blasting and shop priming plant. You may even have to adjust the plant to achieve good blast standards and correct shop primer thickness. A typical blasting and shop primer layout is shown in Figure 17.



Shipyard blasting and shop priming plants are generally located next to the steel stockyard. The steel in these yards will have been produced in a steel mill, and it will generally be covered in millscale, as described in Section 1 of this module. The steel plate will be picked up by overhead gantry cranes and fed into the plant on a conveyor system. In new plants, the plate is fed into the system horizontally. Older plants may feed it vertically.

The first cabinet in the shop priming plant will generally have some kind of cleaning and pre-heating arrangements for washing and degreasing plates and for drying wet plates, or removing ice. From here the plate is fed into the wheel blasting or 'Wheelabrator' cabinet where it is blasted on both sides with metal shot/grit mixtures. Cleaning is carried out automatically in the same cabinet and should remove all abrasive and abrasive dust. After the wheelabrator cabinet, there is generally a short distance of open conveyor where the plate can be examined and the standard of blasting assessed. If you are carrying out inspections you must inspect both sides of the plate. Substandard blasting should be rejected and the plate reblasted. This is also the place to attach test panels to measure shop primer dry film thickness, as described in Module No. 7. The plate then enters the spray booth where it is painted automatically by spray guns traversing both sides of the plate.

Finally, there may be a forced drying or solvent extraction cabinet, to make sure that the plate is dry before it is removed by conveyor into a product area, such as the profile burning or fabrication shop.

6.2 WHEELABRATOR BLASTING STANDARDS

The normal standard of blast given by a Wheel abrator (and required for shop primers) is Sa2½-3 or equivalent. The factors that can adversely affect the standard of this blast are the initial condition of the plate, the type of abrasive used, and the operation of the plant itself. We will look at each factor in turn.

6.2.1 Initial Condition of the Steel Plate

New mill scaled plate will normally give either a white metal finish, or a slightly blue-stained white metal finish. This slight staining is acceptable for shop primers but residual mill scale, even as small islands, is unacceptable because it can very quickly detach taking the shop primer with it.

Well weathered and severely corroded plate may cause more of a problem. The track speed of the conveyor system may have to be slowed down so that the plates are blasted for a longer period to ensure removal of the more deeply embedded corrosion products. Laminations will also become visible after wheel abrator blasting and they must removed by disc-sand or grinding, if possible. However, this is normally carried out prior to the application of the full coating scheme rather than at the shop priming stage.

6.2.2 Wheel abrator Abrasives

Steel shot is normally used as the abrasive in Wheel abrator plants, because it produces less wear on impeller wheel tips than steel grit. The grades used will range up to 1.4mm. The shot is recirculated and gradually becomes worn to a fine dust, which is removed from the system by extractors. Unless the shot becomes contaminated, it is not necessary to change the abrasive. It is merely topped up with fresh abrasive to maintain the required quantity and abrasive 'work mix' for efficient running of the unit and production of the required profile.

If zinc shop primers are to be applied, a mixture of grit and shot should be used with a minimum of 20% grit. This is necessary to provide the required profile. Unfortunately, the grit tends to loose its angular character as the edges are rounded of during use, and it is normal to top up the system with grit rather than shot when using zinc shop primers.

6.2.3 Operation of the Wheel abrator Plant

As mentioned above, blasting is carried out by a series of impellers located above and below the plate. The plate is blasted as it moves through the plant on a conveyor system. The slower the track speed, the higher the standard of blast. It is rarely necessary to adjust the settings of the blasting unit, but mechanical problems can result in inferior blasting. Table 5 may help you to recognize the cause of the problem and suggest the remedial action which should be taken.

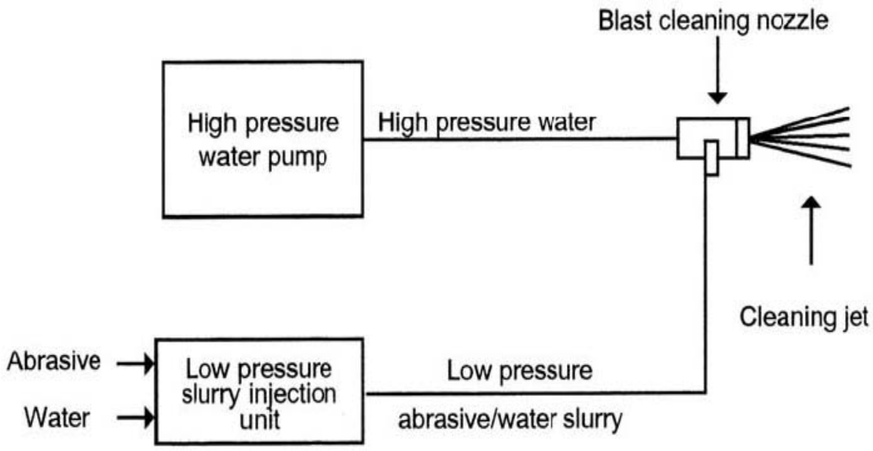
Observation	Cause	Remedial Action
Overall standard of blasting is poor	1. This is normally due to an excessively high track speed. 2. Reduction in the power available for the impeller motors. 3. A restricted supply of abrasive to the impellers due either to feed line blockages or a lack of shot in the hopper.	1. Request a reduction of the plate speed through the wheel abrator cabinet. 2. Request a reduction in the track speed until normal voltage supplies are reinstated. 3. Blockages should be freed or abrasive replenished.
Longitudinal bands of inferior blasting	Incorrect adjustment of the deflectors which direct the abrasive onto the plate.	Adjustment of the deflectors is required.
Longitudinal bands of inferior blasting, associated with low amperage indicated on the ammeter	Electrical faults affecting the motors of one or more of the impellers.	Request that an electrician looks at the plant.
Traverse bands of inferior blasting	This is normally due to the non-uniformity of the track speed.	The drive mechanism of the conveyor rollers should be checked.
Areas of inferior blasting at both edges of the plate.	The plate is too wide for the machine.	Readjustment of the deflectors may remedy this defect, but may also result in a reduction of standards in more central areas of the plate. If this is the case, the edge defects are preferable because welding or cutting is normally carried out at the edge.
Inferior blasting at one edge of the plate.	1. The plate is not positioned in the centre of the rollers. 2. The plate is not activating the impeller tip mechanism.	1. The plate should be positioned to obtain optimum standards. 2. As above.
Loss of efficiency of blasting at the tracking ends of the plate on the upper surface only.	Possible due to inefficient removal of abrasive, thus isolating the plate from impingement of blasting abrasive.	The plant requires repair or modification. As an emergency action, the plate can be inverted and then reblasted.

Table 5 – Adjustment of Wheel abrator Plants

7. SLURRY BLASTING

Slurry blasting is a technique for blast cleaning surfaces with a mixture of water and abrasive. Its major advantage is that it eliminates, or reduces dust, and it is widely used in situations where the dust produced by open grit blasting would create problems. Various types of equipment have been in operation for many years, but the present concern over environmental issues has meant that slurry blasting is becoming increasingly popular. Many manufacturers are developing equipment to fill the gap being left by the demise of open grit blasting. We will look at two of the most common slurry blasting techniques here, pressurized water abrasive blasting and air abrasive wet blasting.

7.1 PRESSURISED WATER ABRASIVE BLASTING



This method essentially adds abrasive to a high pressure water jet. In the system shown in Figure 18, water is pumped to a blast cleaning nozzle from a high pressure water pump. A mixture of water and abrasive slurry is also added to this nozzle from a much lower pressure slurry pump. This results in an effective cleaning jet of high pressure water and abrasive, which is used to blast clean the substrate. This system eliminates dust entirely.

Various types of high pressure water pumps can be used, with pressures ranging from 141 to 2,462kg/sq cm (2,000 – 35,000 psi) and the choice will depend upon many factors including cost, reliability and ultimately cleaning rate. However, you should be aware of some important considerations. Higher pressure pumps use much lower water flow rates to produce the same cleaning effect as lower pressure pumps. These flow rates are usually between 23-68 liters per minute. This has important practical implications. A flow rate of 45 liters minute would require 21,600 liters of water for an eight hour shift. this is a lot of water, and in some areas of the world fresh water is unobtainable, or expensive, which means that salt water may have to be used for blasting. This is undesirable, but is acceptable as long as it is followed by a fresh water wash. Secondly, large volumes of water at high pressure will produce a large back thrust on the nozzle. At back thrusts below 13.6kgs, operators can handle the nozzles for long periods without undue fatigue. At thrusts above 22.7kgs, the nozzle cannot be manually controlled. Low cost, reliable pumps using low volumes of water are therefore best for slurry blasting, provided they can achieve acceptable cleaning rates.

The system shown in Figure 18 mixes water and abrasive together in a special unit, and then pumps this slurry to the blast cleaning nozzle with a low pressure pump. Simpler machines can pump abrasive to the nozzle without mixing with water, or the abrasive can simply be drawn into the nozzle from a hopper, by the venturi suction effect created by the passage of high pressure water.

Various types of abrasive can be used, and the choice will depend upon the cost and the individual application. Hard abrasives such as copper slag and silica sand are used for removing rust and scale and are useful for providing a surface profile. Softer abrasives such as calcium carbonate (limestone) and sodium bicarbonate, can be used where individual layers of paint need to be stripped, or where it is necessary to avoid damaging the underlying substrate, for example, fiber glass or aluminum substrates on the outside hull of minesweepers or yachts.

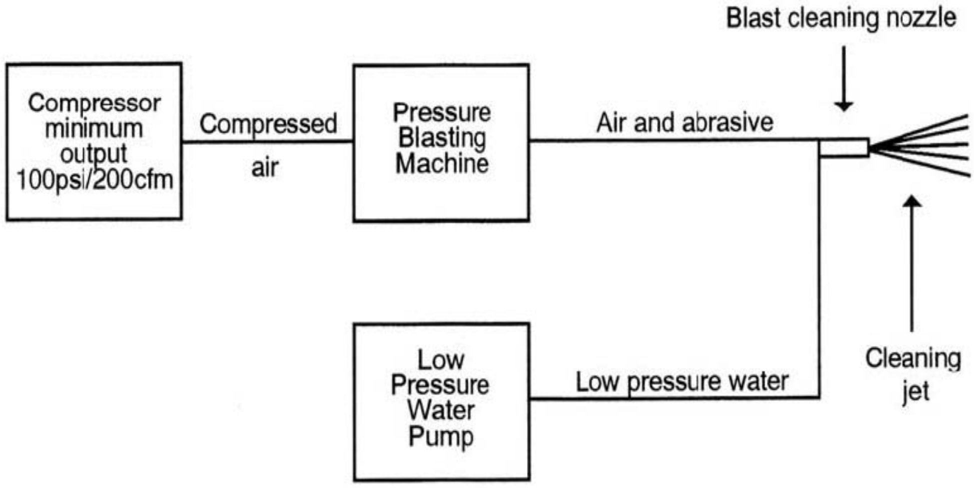
The standard of blasting achieved by pressurized water abrasive blasting can be tightly controlled by adjusting a number as variables, as follows:-

1 The high pressure water pump pressure and flow rate.
2 The abrasive feed rate.
3 The type of abrasive.
4 The stand off distance. The ideal stand off distance of the nozzle from the substrate is 5-8cm (2-3”). Increasing this distance will decrease the efficiency of the blast.

Cleaning rates for these types of slurry blasting systems can vary enormously. Modern machines can match dry blasting rates, while some older machines will only clean at 3050% of the dry blasting rate.

7.2 AIR ABRASIVE WET BLASTING

Air abrasive blasting uses compressed air rather than water as the driving force to propel the abrasive. The various systems generally use modified dry blasting equipment. Water can be added to the abrasive stream at a number of points such as the source of the abrasive, i.e. the blasting machine or pot, downstream of the blast nozzle or just before the nozzle itself. See figure 19.



Other systems fit a ring adapter to a conventional blast nozzle, which envelops the abrasive stream in water. This 'water curtain' method does not mix the abrasive with water, but the water shroud itself can reduce dust levels by 50-70%. Many blasting operators will switch off the 'water curtain' mid way through a blast if they think they can get away with it, and continue to blast the job as a normal dry blast operation.

Because abrasive wet blasting uses conventional dry blasting equipment rather than high pressure water technology, the cost of the equipment is relatively low, the reliability is high, and the cleaning rates are generally 80-90% of dry blasting rates.

7.3 ADVANTAGES AND DISADVANTAGES OF SLURRY BLASTING

Both the pressurized water and air abrasive systems of slurry blasting have several advantages and disadvantages over other methods of surface preparation, which we will look at here.

7.3.1 Advantages of Slurry Blasting

1. Dust Reduction

As mentioned above, slurry blasting is widely used because it eliminates or reduces dust pollution. The pressurized water systems are more effective in this respect than air abrasive systems.

2. Salt Removal

You will be aware that the removal of soluble salts from substrates is extremely important to the performance of coatings. All slurry blasting systems are better at salt removal than dry blasting systems, because the surface is washed as it is blasted. This is a major bonus for slurry blasting, with the pressurized water systems being far superior to the air abrasive systems The higher the water pressure, the better the salt removal.

3. Surface Profile

Slurry blasting will produce a surface profile on steel, and this is an important consideration for many coatings. Reports from the 'American Steel Structures Painting Council' indicate that there is little difference in the profile produced by slurry or dry abrasive blasting.

4. Reduction of Abrasive

Slurry blasting can reduce the amount of abrasive needed to clean a surface. Some of the pressurized water systems can reduce it by 40%. There is a cost saving for the operator in both the purchase of abrasive and its disposal. Disposal costs are significant for most operations, but they become very large if spent abrasive is classed as special or toxic waste and has to be sent to special land fill sites.

7.3.2 Disadvantages of Slurry Blasting

1. Rates of Cleaning

As mentioned above, rates of cleaning are generally lower for slurry blasting than dry abrasive blasting.

2. Costs and Reliability

The cost of slurry blasting equipment, both to purchase and maintain, is likely to be greater than dry blasting equipment. The complexity of the equipment also means that reliability may be suspect. 'Contractor friendly' equipment is available but it will still require more maintenance than dry blasting equipment.

3. Awkward Areas

It can be difficult to clean awkward areas. In dry blasting, the operator ricochets the abrasive into areas where he cannot get direct access with the nozzle. The water in slurry blasting systems prevents or inhibits this technique.

4. Poor Visibility

Water spray, or mist can create visibility problems for slurry blasting operators. This can make blasting difficult, especially in enclosed spaces where forced ventilation may be required to eliminate the problem.

5. Removal of Wet Abrasive

Removing wet abrasive is more difficult and costly than removing dry abrasive. The normal cleaning techniques of brushing, vacuum cleaning and blowing down, may not be practical.

6. Washing Down Slurry Blasted Surfaces

Wet abrasive will tend to stick to slurry blasted surfaces, which must be washed down to remove the abrasive prior to paint application. This is an easy matter in most instances, particularly in pressurized water systems, where the abrasive stream is simply switched off, and the pressurized water used for washing.

7. Flash Rusting

All steel surfaces which have been slurry blasted will flash rust as a result of the contact between water and steel. The light colored red/brown ferric oxide produced, is in itself a fairly inert material that will not cause further corrosion of the steel if it is left in place.

However, it is loosely bonded to the steel, and heavy deposits may cause coating adhesion problems. Flash rusting can be removed by bristle brushing, by further dry abrasive blasting, or simply washing down with high pressure water. The important thing to remember is that the degree of flash rusting which is acceptable, is dependent upon the paint product being applied, and upon its expected service environment. International Paint's slurry blasting visual standards will help you relate degrees of flash rusting with product acceptability.

8. Chemical Corrosion Inhibitors

Flash rusting can, of course, be prevented by the use of chemical corrosion inhibitors, which work by polarizing the surface and altering the potential of either anodic or cathodic areas. The inhibitors commonly used are water soluble salts based upon nitrites and phosphates. The use of chromate based inhibitors has declined in recent years because of the health and safety and environmental problems associated with them. Inhibitors should be added to the water used for blasting according to their manufacturers instructions, normally at concentrations between 100 and 3000 parts per million. To do this properly can require the use of metered chemical pumps. Unfortunately they are rarely available, and in reality far too much inhibitor is usually added to the water. This results in a crystalline material forming on the surface of the steel when the water evaporates. If coatings are applied directly over this material, it can cause loss of adhesion and osmotic blistering, with localized corrosion occurring, particularly on the top of welds. Because of these problems, International Paint **do not** recommend the use of corrosion inhibitors to hold wet blasted surfaces. If inhibitors are used, they **must** be thoroughly washed off before paint is applied, and of course, if this happens the surface will flash rust anyway.

8. WATER JETTING (HYDROBLASTING)

Previously generally known as hydro blasting, since the production of International Standard ISO 8501-4, water jetting has been adopted as the preferred description for a method of surface preparation which relies solely on the energy of high and ultra high pressure water striking the substrate to achieve its cleaning effects. It **does not** use abrasive in the water stream, and there are therefore no pollution problems caused by dust and the disposal of spent abrasive. Because of this, and its ability to give excellent standards of surface preparation, water jetting is gaining Worldwide acceptance as a viable alternative to dry abrasive blasting.

Water jetting and high pressure washing are often confused, because they both use the same type of equipment and technology. To clarify the situation it is worthwhile setting out the following definitions which are generally accepted in the industry and form the basis of the NACE/SSPC standard on high and ultra-high pressure water jetting.

1 Low Pressure Water Cleaning

Water washing performed at pressures less than 34Mpa (5,000 psi).

2 High Pressure Water Cleaning

Water washing performed at pressures between 34-70 Mpa (5,000-10,000 psi).

3. High Pressure Water Jetting, or Hydrojetting

Water jetting will prepare a surface for recoating utilising water pressures between 70 Mpa and 170 Mpa (10,000-25,000 psi).

4. Ultra High Pressure Water jetting

Cleaning performed at pressures above 170 Mpa (25,000 psi). Most ultra high machines presently operate between 207-250 Mpa (30,000-36,000 psi) although higher pressure machines are also becoming available.

The essential components of a water jetting system are a water supply, a high pressure pump powered by a motor, fluid lines and a jet lance. Some systems also include water containment, filtration and reclamation systems for the spent water. We will look at each component in turn. See figure 20.

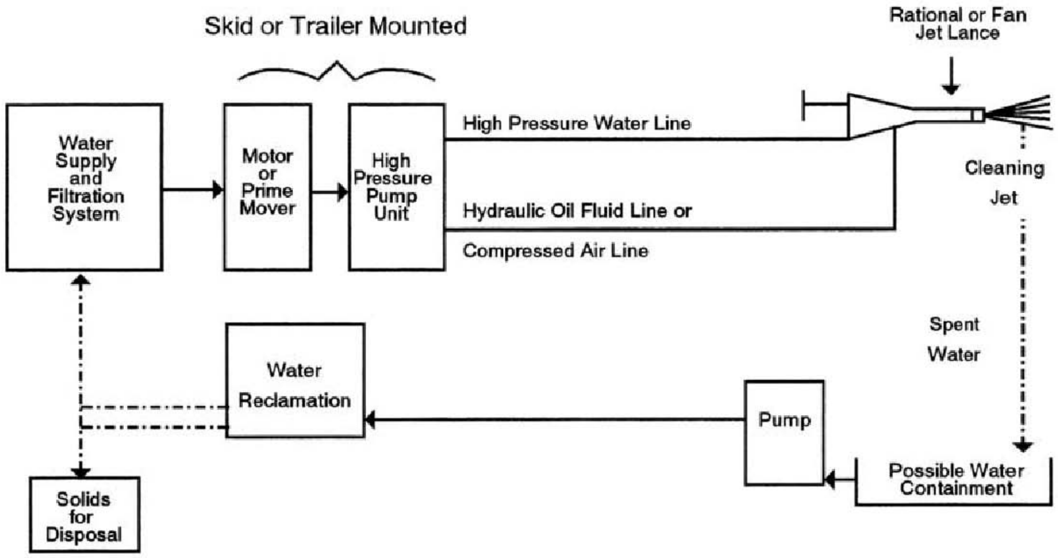


Figure 30 - Water Jetting Flow Diagram

8.1 WATER SUPPLY

The quality of the water used for water jetting is critical. Potable quality water is preferable, so that it does not impose additional contaminants on the surface being cleaned. However, water with a maximum conductivity of 400 micro siemens/cm may be used. It is also critical that the water does not contain sediments or other solid particles that can damage the pump unit itself. Having said that, sufficient quantities of potable water are not always available for water jetting, and some pump manufacturers, particularly the high pressure ones, will allow salt water to be used in their pumps, providing it is passed through a very fine filtration system first. Obviously, where salt water is used for water jetting, it must be washed off the prepared surface with fresh water prior to the application of coatings. The pump itself must also be flushed with fresh water to avoid corrosion problems. The quantity of water available for water jetting is also important, flow rates very between 9-68 liters per minute for the operation of one lance. Therefore, when large jobs are undertaken, particularly with riding crews on board ships, arrangements must be made for suitable supplies of water. As described in the slurry blasting section, back thrust pressure on the lance can be a problem. However, modern water jetting units use low volumes of water at high pressure and when this back thrust pressure is dissipated by the rotational nozzle lance and the lance itself is supported by a body harness, the jet lance can be handled for long periods without undue operator fatigue.

8.2 WATER JETTING PUMP UNITS

The pump unit and its motor or 'prime mover' are usually mounted on a skid, a trailer, a truck, or inside a container. This can mean that water jetting equipment is less mobile than other surface preparation equipment, and that long fluid lines have to be utilised from the pump unit to the work place. The motors themselves can be electric or diesel powered, but for site work, diesel motors are generally used. Power outputs can vary tremendously, but some of the larger pump units are driven by 298 kw (400hp) motors. The pump units can be of a plunger pump, piston pump, or intensifier type, with intensifiers mainly confined to ultra high pressure machines. Reliability of the pump units has always been the main problem with high and ultra high pressure pumps, and this combined with their initial cost and high maintenance costs has stopped the uptake of this technology into the shipbuilding and repair markets for a number of years. However, the pump units are now becoming more 'contractor friendly', although they will never be as simple to maintain as compressed air blasting equipment and will require a skilled pump fitter to be available on site. These maintenance requirements must be taken into account when setting up water jetting contracts.

8.3 FLUID LINES

Some pumps are able to accommodate more than one fluid line and jet lance offtake, but most pumps can only operate one jet lance. The high pressure water lines must be able to withstand extremely high peak pressures, and the toughest lines have minimum burst pressures in excess of 6,330kg/cm^2 (90,000 psi). These lines are reinforced by layers of high tensile steel wire. In addition to these water lines, some types of jet lance have a rotational nozzle driven by hydraulic oil or compressed air and these lines run in parallel to the water lines from the pump to the lance.

8.4 JET LANCES

There are basically two types of lance used in water jetting. The fan jet lance and the rotational nozzle lance. As the name suggests, fan jet lances produce a simple fan jet of water, and they are very similar to the type of lance used for high pressure water washing. Fan jet lances can be used with high and ultra-high pressure units.

Rotational nozzle lances are used with both high and ultra high pressure units. They have tips with multiple orifices at various angles, that rotate at up to 2000 rpm whilst delivering the water at extremely high pressure and speed. At 2,530kg/cm^2(36,000 psi) the water velocity is almost 700 metres per second. This means that a rotational lance is a high energy density cutting tool, that enables the water to get behind coatings or rust and scale, removing them far more efficiently than a fan jet lance. The energy imparted by the water is enough to locally heat up the steel substrate and assist in drying off the water, consequently limiting flash rusting. Unfortunately, this energy also creates steam (as well as the normal aerosol spray associated with water jetting) and this limits visibility in enclosed spaces.

The water energy is dissipated within a very short distance from the nozzle, which means that a stand off distance of nor more than a few inches is required if the blasting is to be effective. This stand off distance requirement can cause major problems during water jetting, because it is impossible to get the jet lance into awkward places. Extension pieces can be fitted to lances to extend reach, but angled nozzles on extension pieces will be required for some applications. For safety reasons, most jet lances are equipped with cut off triggers which stop the water flow and depressurise the fluid lines, and some countries actually specify minimum lance lengths in an attempt to protect operators from the high pressure water jet.

8.5 WATER CONTAINMENT FILTRATION AND RECLAMATION SYSTEMS

In some situations, such as the removal of lead based paints, or tin based antifoulings, the spent water and solids produced by water jetting may be classed as special, or even toxic waste. A containment and reclamation system which filters out the solids and reuses the water will reduce the quantity of waste and save money on disposal costs.

The automatic water jetting equipment installed on dockarms or other mobiles in some shipyards has a built-in containment system. The rotary jet heads are enclosed in a dish, which is moved across the surface being blasted. The water and solids are removed by a vacuum system for filtration and separation., rather like the vacuum system already described. Smaller water jetting units for deck cleaning operate on a similar principal. However, the containment and reclamation of water used in manual water jetting systems is more difficult, with each application being treated separately.

8.6 ADVANTAGES AND DISADVANTAGES OF WATERJETTING

Both the high and the ultra high pressure systems of water jetting have advantages and disadvantages over other methods of surface preparation which we will look at here.

8.6.1 Advantages of Water jetting

1. Reduction of Pollution

Water jetting does not produce dust pollution. This means that areas adjacent to blasting operations do not have to be washed down prior to painting. There are no problems associated with the disposal of spent abrasives, and as you can see from your answer to ITQ 16, treating and disposing of water jetting waste may be cheaper than disposing of spent abrasives.

2. Safer Working

The dissipation of water energy within a few inches of the jet lance means that other trades can work in the vicinity of water jetting without the health and safety problems associated with high velocity particles. Another advantage is that water will not produce sparks. Water jetting is therefore safer than grit blasting in flammable environments.

3. Salt Removal

Ultra high pressure systems are excellent at removing soluble salts such as sulphates, phosphates, chlorides and nitrates. Laboratory tests carried out on a variety of surfaces with varying degrees of contamination have shown that salts were reduced to levels ranging from 0-2 micrograms/sq.cm. These levels are generally accepted as safe levels for overcoating. During actual site work they ranged up to 10 micrograms/ sq.cm. but in all cases the levels were considerably lower than those achieved by abrasive blasting.

4. Standards of Surface Preparation

Water jetting is generally able to achieve good levels of surface preparation depending upon pressure, substrate and the time taken to achieve the standard. Ultra high pressure machines will give equivalent Sa2-Sa2½ standards on **virtually all substrates**, while high pressure machines will only achieve equivalent Sa2-Sa2½ on **some substrates**. The problem is that water jetted surfaces do **not** look the same as abrasive blasted surfaces, because the top layer of metal is not cut and deformed by abrasive, and it looks dull even before it flash rusts. The production of visual standards for water jetted surfaces is being addressed by NACE/SPCC and ISO at the present time. However International Paint have already produced their own 'Hydroblasting Visual Standards' which are being widely used in the industry. However, once ISO 8501-4 is published, it will supercede our own standards.

8.6.2 Disadvantages of Water jetting

1. Cost and Reliability

Water jetting machines are expensive to buy and maintain. Maintenance costs per annum have been estimated at about one fifth of the purchase cost, i.e. a £100,000 ultra high machine might cost £20,000 per year to maintain. This may cause a major problem in some parts of the world, where spare parts and service are unavailable. The maintenance and operation of these machines must also be carried out by skilled personnel. These factors obviously increase the cost per square metre blasting rate charged by contractors.

2. Awkward Areas

It can be difficult to clean awkward areas, because it is impossible to ricochet water. Angled nozzles are under development to overcome this problem.

3. Visibility

Aerosol mist and steam can create severe visibility problems for operators who are water jetting in enclosed areas. Forced ventilation may overcome some of the problems. Other solutions have included search lights attached to lances, and even a camera eye fixed to the jet lance, which displays a picture of the work piece inside the operators blasting helmet.

4. Flash Rusting and the Use of Inhibitors

The problems of flash rusting and the use of inhibitors are the same in water jetting as they are in slurry blasting. You should note that heavy flash rusting can be removed by sweeping the surface with the water jet, leaving lighter flash rusting as the surface dries. However, in regions of the world where humidity is high, it should be recognised that light flash rusting may not be achieved.

5. Lack of Surface Profile

Water jetting will not produce a surface profile on steel. However, the existing profile produced by previous blasting in a shop priming plant, or at maintenance and repair work will be exposed.

6. Sub-Zero Temperatures

If water jetting is carried out at temperatures below freezing point, there is a danger that the water may freeze on the surface being prepared. Paint could then not be applied to the surface until dry and in the intervening period the surface could corrode.

8.7 APPLICATION OF WATER JETTING IN MAINTENANCE, REPAIR AND NEWBUILDING

The environmental pressures that are forcing shipyards to adopt water jetting means that you will encounter the technique in a variety of situations. The following comments may be helpful.

8.7.1 Maintenance and Repair Applications

1. Outside Hull

Water jetting is suitable for spot blasting and for full blasting to both sweep blast and full Sa2-Sa2½ equivalent standards. It can also be used for stripping individual coats of paint, without damaging underlying layers by increasing the jet stand off distance. This may be useful if antifouling paint has to be removed from anticorrosive paint. Visibility will not be a problem on an outside hull. Water will run off surfaces fairly quickly, allowing them to dry naturally. However, flat bottoms may have to be force dried with compressed air.

2. Decks

Water jetting is especially suitable for cleaning decks. The process tends to remove oil and grease by emulsification as blasting takes place, and there are no abrasives to get into valves and other sensitive equipment. There may, however, be access problems for the lance with risers, pipes and external stiffening. Vacuum recovery water jetting equipment is often used for deck work.

3. Ballast Tanks

Water jetting may be difficult in ballast tanks, because of access and visibility problems. High humidity and limited ventilation can also cause very heavy flash rusting. However, the huge advantage of salt removal and the size of the ballast tank coating market, will ensure that these problems are eventually overcome.

4. Cargo Tanks

Water jetting may have limited suitability for cargo tanks. The practical problems outlined above may be overcome, but many high performance tank coatings, cannot be applied over flash rusted surfaces until long term performance can be ensured and performance guarantees can be issued by International Paint to shipowners.

8.7.2 Newbuilding Applications

1. Shop Priming Plants

Water jetting may be capable of removing millscale at pressures above 2,800kg/cm^2 (40,000 psi) but it is never likely to be as economical as Wheelabrator blasting, and it does not produce the required surface profile.

2. Unit Stage of Construction

There is some potential for water jetting welds and sweep blasting shop primer at this stage of construction.

3. Outside Shell and Decks

Water jetting is suitable for blasting join-up welds. Other trades can work in fairly close proximity without disturbance.

4. Ballast and Cargo Tanks

Water jetting may have limited suitability because of the problems mentioned above. Some of the access and ventilation problems can be overcome if work is carried out at the block stage.