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Paper

BEYOND WATER JETTING

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ABSTRACT

Beyond Water Jetting touches on several subjects that have to do with water jetting and high-pressure positive displacement pumps used in various fields. It includes discussions of up to 40,000-psi water jetting, water blasting applications and other fields of application. Water jetting is used to perform surface preparation, cleaning and cutting operations, but the discussion moves to other fields of application for the technology developed by the water jetting industry over the last 40 to 50 years. Examples of hydrostatic testing equipment that is currently being produced and used in the Oil & Gas industry are discussed. A specialty product for sub-sea flushing operations, wellhead device testing and chemical pumping are also reviewed. Photos of equipment to support the discussion are included in the paper and the presentation will use slides that are germane to the topics being discussed.

1.0 INTRODUCTION

The WaterJet Technology Association (WJTA) has helped to increase the use of water jetting in many fields of application. It has brought the academic world in touch with the industrial workplace using high pressure water jetting, water blasting and Ultra-High pressure to accomplish a given task. Since its creation in 1983, the WJTA has pursued its objectives of providing a means of cooperation between government, industry, university and research institutions. It has promoted the interests of water jetting applications and established recommended practices used in the industry. Water jetting is presently being used in almost every industry and the heart of the equipment is the pump. The development of the high-pressure pump, intensifier and Ultra-High pressure pump has been largely because it was needed by an evolving industry, water jetting. Now that these pumps are available, new uses and new markets are developing for the manufacturers and packagers of pumping equipment. This paper explores some of the uses for pump technology BEYOND WATER JETTING.

2.0 HISTORICAL BACKGROUND

Positive displacement pumps in the United States were probably first used to transfer fluids and developed over the years because of the need to pump more types of fluid at ever increasing pressures. The Oil & Gas Industry used the plunger and piston pumps to move crude oil and petroleum products at moderate pressures with great success. Innovative people developed the fluid block/cylinder designs, the packing designs and the valve designs to handle up to 10,000 pounds per square inch (psi), then 20,000 psi, then 36,000 psi and then 40,000 psi. When each plateau was reached and the pump designs were barely debugged, someone was looking to go the next step to reach the next plateau. Some of the Ultra-high pressure pumps/intensifiers are climbing to 55,000 psi and beyond. Where it stops, no one knows, but each break-through leads to the next plateau (where material, hoses, connections & accessories have to catch-up). The design of high-pressure pumps has progressed to the present technology to handle the many fluids needed by modern industry.

Power End designs have been around for a long time and have been used by builders of high-pressure systems who could provide their own fluid ends to handle 10,000 psi, 15,000 psi and 20,000 psi. As part of the evolvement of power frames for high-pressure pumps, the material has improved over the years. In addition to greater horsepower pump units, higher-pressure systems brought more revenue to contractors in the 1980 economic down turn when they offered 36,000 psi to clean hard to remove substances from heat exchangers and reactors. Material selection has played a part in improving pump power ends by using forged steel crankshafts instead of cast iron and by the use of better bearings for increased rod load capability.

The history of high-pressure pumps is discussed in a paper (Ref. 6.1) that includes the use of oil field pumps to do cleaning in the 1940's and 1950's. Some of the many uses for high pressure fluid are discussed such as Chlorine Cell Cleaning, Water Expeller Cleaning, Runway Cleaning, Automotive plant systems, Rubber Crumb Conveyor cleaning, Cleaning Cabinets, Cable Washers, Airplane Cleaners, Rocket Washout Systems and Hot Water Wash down units.

3.0 WATER BLASTING AND WATER JETTING

In addition to specialty systems, the general applications for water jetting include cutting, cleaning, surface preparation, and coating removal. The topic is too broad to explore in this paper, but one area that has become accepted in the painting and maintenance industry is the use of Ultra-High water jetting to remove a variety of coatings. **Figure 1** shows a diesel powered skid mounted pump unit for hand held gun operation at 40,000 psi and 8 gallons per minute (gpm). This type of unit is being used offshore for removal of failing exotic coatings that need to be stripped off to do the repainting operations. This pressure at various flows has been very effective and can replace dry sand blasting. The studies of flash rust, production rates and pollution control have been helpful to the industry. A paper given at a WJTA conference (Ref 6.2) relates a study of flash rusting after water jetting and (Ref 6.3) discusses the continual improvement in water jetting operations. Another paper (Ref. 6.4) indicates that the major coating manufacturers have realized the advantage of using Ultra-High Pressure Water Jetting (UHPWJ) for certain surface preparation jobs.

4.0 OTHER FIELDS OF APPLICATION

4.1 Hydrostatic Testing

Hydrostatic testing is an application for the water blast type pump that has been around for many years. The author's first encounter with this type of equipment was in a pipe yard where drill pipe was being tested in the early 1970's. The unit was similar to a diesel driven, trailer mounted water blaster, but had a centrifugal pump driven by a jackshaft to fill the pipe before pressure testing. Some of the present hydrostatic test units are used for blowout preventor (BOP) testing as shown in **Figure 2**. This 100 horsepower diesel driven unit is capable of operating at 15,000 psi and 8 gpm and a larger hydrostatic testing for pipeline service is shown in **Figure 3**. This offshore packaged equipment will operate at 10,000 psi at 27 gpm with its 200 horsepower diesel driver. The key difference between a water blasting/jetting unit is the controls used for hydrostatic testing which includes special valveing, gauges and chart recorder.

Figure 4 shows a typical hydrostatic control grouping with remote operated power take-off, engine controls, level operated pressure-up valve, chart recorder isolation valve and pressure bleed valve.

4.2 Flushing Units

Flushing bundles of hose used for umbilical offshore applications is a new technological use for pumps, valves and controls that were developed in the water jetting industry. The unit shown in **Figure 5** includes a 400-gallon stainless steel tank, a variable frequency drive, 100 horsepower electric motor and a plunger pump for operation from 6,000 psi to 10,000 psi. The equipment is mounted inside of an offshore four-point lift skid that was also developed from water jetting technology. These units vary in size and amount of hardware and much of the flushing takes place at around 5,000 psi or the working pressure of the hose being flushed. **Figure 6** shows a flushing unit without an onboard tank, having a plunger pump, constant speed 75 horsepower

electric motor and stainless steel plumbing to handle the fluid used in the flushing operation. The objective of flushing the umbilical hoses is to remove impurities from the hose internal diameter by creating a high turbulence. The operation requires classifying the cleanliness of the return fluid and it must conform to NAS 1638. The time it takes to meet the requirement depends on length of hose and amount of impurities, which are measured by taking samples for laboratory examination.

4.3 Other Applications

The applications for high-pressure pumps developed in the water jetting industry include methanol pumps for offshore applications that are used up to 15,000 psi. As an example of the various pumping equipment, eight pump packages for glycol service were supplied to a Houston based engineering group about a year ago to replace damaged equipment in Iraq. The oil & gas industry uses a variety of positive displacement pumps such as a 350 horsepower piston pump for salt-water disposal being installed on an offshore platform near China. Cryogenics such as liquid nitrogen (NL2) and hot products such as Skydrol are handled by high-pressure positive displacement pump. A government agency pumps NL2 at 6,000 psi, 15.6 gpm at a temperature of –325 degree Fahrenheit to add to the list for pump technology.

5.0 ACKNOWLEDGEMENTS

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6.0 REFERENCES

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7.0 GRAPHICS

Figure 1

Figure 2

Figure 3

Figure 4

Figure 5

Figure 6