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Application of Ultrasonic Methods in Super POD Thickness Measurement Examination

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Abstract

NDT is a scientific field of engineering that includes testing and inspection of materials and equipment which is useful for evaluating a condition, finding deficiencies and defects, and also extending the useful life of the infrastructure used. The main difference between non-destructive testing and other forms of material evaluation is that non-destructive testing allows evaluation or inspection of parts on site without having to permanently modify or damage the part. In maintaining the credibility of the company's services, the company adopting NDT/NDE testing techniques in carrying out regular inspections or checks on the tools used, one of which is the application of the ultrasonic method on the Super POD (Programmable Optimum Density). Based on this background, the author chose the theme of the study to write a scientific paper entitled "Application of Ultrasonic Methods in Super POD Thickness Measurement Examination". The SBF-624 Super POD (programmable optimum density, POD) is a trailer-mounted fracturing service blender that can blend and pump up to 120 barrels per minute of fracturing slurry. The Super POD computers precisely control the solid-to-liquid ratio of the prop pant at design values in either ramp or stair-step mode. The results of observations of objects that have been inspected using the ultrasonic method, namely measuring the thickness of the Super POD SBF 624, from the good results without any defects being detected, and cleaned in surface condition so it can be said that the machine has shown good effective results and can meet the standards for using tools for the company.

Keywords: Nondestructive, Ultrasonic, Inspection, Thickness, Measurement

Introduction

Every company certainly wants to be providing the best service for their customers. As a company that operating in the oil and gas sector (IVANOVA, 2023), of course, this is done carefully in maintaining the company's credibility. Some of them work each day on decarbonizing industry, innovating in oil and gas, delivering digital at scale, and developing

and scaling new energy systems that accelerate the energy transition. One of the companies operating in the service sector is carrying out inspections using careful checking methods for objects, especially if the object being inspected is expensive (Bayat et al., 2023). The effort made is to examine the material or test materials using non-destructive methods as it is known that there are several tests in this test.

NDT is a scientific field of engineering that includes testing and inspection of materials and equipment which is useful for evaluating a condition, finding deficiencies and defects, and also extending the useful life of the infrastructure used (Feklunova & Boldyreva, 2023). The main difference between non-destructive testing and other forms of material evaluation is that non-destructive testing allows evaluation or inspection of parts on site without having to permanently modify or damage the part (Zhanibekov & Stanislav, 2023). A variety of technologies developed generally for medical imaging are used in these non-destructive tests. There are many companies that already have experience using non-destructive testing technology from the medical industry, oil and gas industry, manufacturing industry, and other industries. X-rays, ultrasound, and flexible scopes are all used in both fields with some of the devices being almost exactly the same. There are several non-destructive tests including: Visual or Optical Testing, Magnetic Particle Testing (MT), Ultrasonic Testing (UT), Radiography (RT), Penetrant Testing, Eddy current testing, Leak Testing, Acoustic Emission Testing (AET).

There are several non-destructive inspection methods used to evaluate the integrity of industrial equipment. This is to see which method is the most reliable, which provides a lower risk of decision making, and the ideal method for a particular type of equipment. More reliable inspection methods are also more affordable(Ma'arif et al., 2023). Some of the things that are of concern in the study are methods for estimating the reliability of non-destructive testing which aims to provide better operational reliability of equipment in various branches of industry.

The inspection procedure can be determined with two objectives, namely:

1. Detect defects with any dimensions, or detect defects in certain dimensions, or also detect certain types of defects;
2. State whether the part being inspected is free from defects, or if the part being inspected is free from larger defects of certain dimensions, or also that the part is free from certain types of defects.

Non Destructive Testing (NDT) or Nondestructive Evaluation (NDE) refers to inspection techniques used to detect, discover and assess defects or defects in materials or structures or fabricated components without affecting their usability or serviceability in any way. The resulting defects may intrinsically arise as a result of the manufacturing process or may be caused by stress, corrosion, etc. that the material or component may experience during actual use. Thus it becomes clear that techniques for detecting critical weaknesses before they become very large are of critical importance in industry for in-service inspections, quality control, and failure analysis.

NDT can rely on the use of electromagnetic radiation, sound, and the inherent properties of materials to examine samples. Generally, the destructive surface must be made smooth through polishing or the sample must be electron transparent in thickness. The interior of the sample can be examined by penetrating electromagnetic radiation, such as X-ray or 3D X-ray.

Non-Destructive Testing is very useful because it does not damage a component or material, thereby saving costs and time in evaluating materials, solving material problems and researching materials. Make every effort to ensure that the tool material does not experience failure during its period of use. NDT is carried out at least twice. First, during and at the end of the fabrication process to determine whether a component is acceptable after going through the fabrication stages. This NDT is used as part of component quality control. Second, NDT is carried out after the component has been used for a certain period of time. The goal is to find partial failures before they exceed their damage tolerance. NDT methods can rely on the use of electromagnetic radiation, sound, and material properties to examine samples.

Ultrasonic Testing (UT)

Ultrasonic testing requires the transmission of high frequency sound into a material to interact with features within the material that reflect or attenuate it. Ultrasonic testing is broadly divided into Pulse Echo (PE), Through Transmission (TT) and Time of Flight Diffraction.

1. Pulse Echo Inspection (PE)
   This technique introduces a sound beam to the surface of the test material. Sound will travel through the part, either reaching the back wall of the material and then returning to the transducer or returning earlier when reflected from discontinuities within the part. If the acoustic speed is known, the recorded time interval is then used to obtain the distance traveled in the material.
2. Transmission Testing (TT)
   TT uses separate transducers to transmit and receive sound. The sending probe is positioned on one side of the test sample and the receiving transducer is positioned on the other side. As sound passes through a component, it is attenuated by features within it, such as porosity. Thickness measurements are usually not possible with this technique.
3. Time-of-flight diffraction (TOFD)
   Is the method of ultrasonic testing is a sensitive and accurate method for the nondestructive testing of welds for defects. Ultrasonic testing is an NDT test that uses high frequency sound waves to detect defects or changes in material properties. This test can also be used to measure the thickness of various types of metal and non-metal materials by simply checking from one side.

In maintaining the credibility of the company's services, the company adopting NDT/NDE testing techniques in carrying out regular inspections or checks on the tools used, one of which is the application of the ultrasonic method on the Super POD (Programmable Optimum Density). Based on this background, the author chose the theme of the study to write a scientific paper entitled "Application of Ultrasonic Methods in Super POD Thickness Measurement Examination".

Research Method

According to Sugiyono (2019), qualitative research method is a research method based on the philosophy of post positivism, used to research the conditions of natural objects, (as

opposed to experiments) where the researcher is the key instrument, data collection techniques are carried out in a triangulated (combined) manner, data analysis is inductive/qualitative, and the results Qualitative research emphasizes meaning rather than generalization

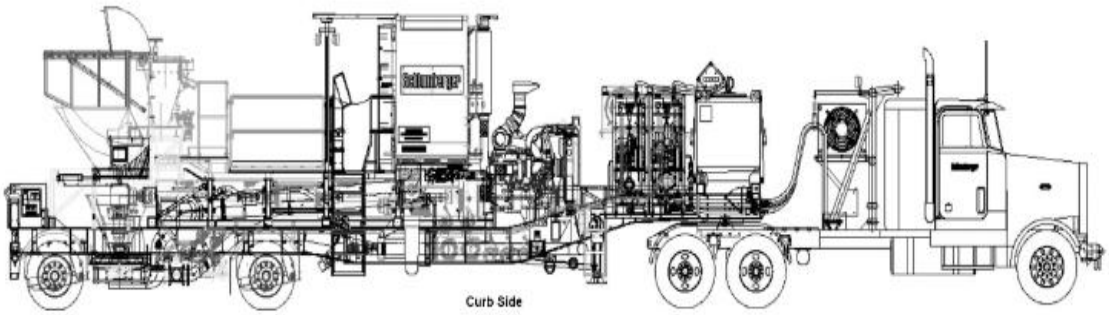
The type of research chosen in carrying out this research is descriptive which uses analysis of objects through a qualitative approach where the process and meaning of the research is emphasized with a literature review as a guide to focus on research based on facts in the field. The aim of descriptive research is to provide an explanation and describe the phenomena and events being studied. Research is limited to non-destructive testing using ultrasonic methods to measure the thickness of Super POD (Programmable Optimum Density) as part of regular inspections. This research has aim to see has the ultrasonic testing method shown a good effective results.

The data collected will be processed through NDT testing, namely ultrasonic. Testing equipment with portable ultrasonic testing technology is a test that does not damage the material or is commonly known as a non-destructive test, the way it works is by providing a high frequency wave into the material or test object which functions to measure geometric and physical properties. of materials. Basically the frequency used is in the range of 1 MHz to 10 MHz

Result and Discussion

The SBF-624 Super POD (programmable optimum density, POD) is a trailer-mounted fracturing service blender that can blend and pump up to 120 barrels per minute of fracturing slurry. The Super POD computers precisely control the solid-to-liquid ratio of the prop pant at design values in either ramp or stair-step mode.

Mixing is accomplished with two independent, side-by-sides, 60-barrel-per-minute vortex mixers without the requirement of an averaging tub. The prop pant is gravity-fed into the mixer from the deck-mounted prop pant hopper where it is instantly blended with clean fracturing fluid and discharged at a maximum discharge pressure of 100 psi (6.8 bar). The fluid suction into the Super POD is accompli shed through a C-pump (10 ×12) to fill up the on-board header tank, capable of holding 40 barrels of fluid. The level of this header tank is controlled and maintained constant by a variable valve to ensure optimum suction conditions for the mixers. The Super POD is powered by two 500-horsepower Caterpillar C-12 diesel engines. The C-pump is hydraulically driven using the tractor engine.

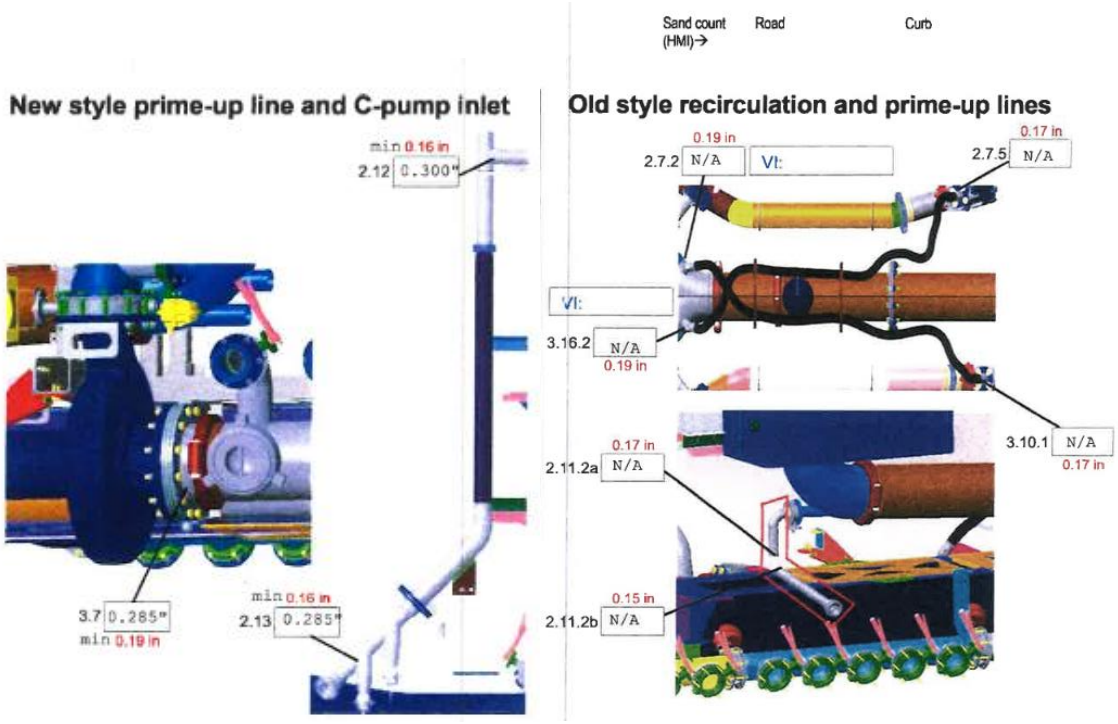


Picture 1. Super POD SBF-624
Source: Sch. Company.

The main functions of this machine include:

- ✓ Mixes and pumps up to 120 barrels per minute of fracking slurry.
- ✓ Provides two completely redundant and separate prop pant mixing systems.
- ✓ Precisely control the liquid/solid ratio at the design value.
- ✓ Loading and pumping two liquid additives into the mixer (suction or discharge).
- ✓ Meters dry additives into both mixers, meters fiber into both mixers,
- ✓ Capable of transporting up to 700 gallons of li quid additives in two removable tote tanks.

When using the ultrasonic method in testing the object, the company have the standard to safety the worker to do. The steps to do the job are get the ultrasonic measuring tool and the related instructions from around the district. Use the glycerin couplant or vase line is necessary to take measurements with the ultrasonic tool. In roadside: Get a copy of the Ultrasound Inspection worksheet (the last page of this SWI) and record minimum measurements on the worksheet. Measure the thickness along and around the diameter of the 6-in discharge spools and record the minimum thickness. Examine the spool pipe and densitometer visually for erosion. (The discharge spools extend from the road-side vortex mixer.). also measure the thickness along and around the first bend of the 6-in road-side discharge piping and record the minimum thickness., measure the thickness around the second bend of the road-side discharge piping and record the minimum thickness, measure the thickness around the second bend of the 6-in road-side discharge piping and record the minimum thickness. Measure the thickness of the 10-in road-side suction piping and record the minimum thickness, measure the thickness around the nipple of the road-side recirculation line connection and record the minimum thickness. Disconnect both recirculation lines at the fittings on top of the suction piping. To the areas that can be difficult to examine, so use a flashlight (or suitable illuminating device) for inspection and a bore scope when available. Measure the thickness of each port on the road-side.Record the findings of the discharge manifold visual inspection on the worksheet. If corrosion, scaling, or wear is on the discharge manifold so speak to the shop lead about replacement of the discharge manifold. Replacement can be necessary even when the minimum thickness is in permitted tolerance. Measure the thickness of the road-side corner bend of the discharge piping and record the minimum thickness.



Picture 2. The Ultrasonic Thickness Of Super POD SBF-624
Source: Sch.Company.

From the picture above the result of ultrasonic test has been used in super pod SBF inspection with it used equipment probe in 5MHz frequency on low pressure piping. The result was cleaned in surface condition. There were no defect indication observed during the inspection has accepted. The thickness reading and accepted according to inspection procedure.

Conclusion

Ultrasonic Testing has a working principle where ultrasonic waves are shone onto a surface of the plane being tested in a straight line at a constant speed, then the ultrasonic waves will be reflected again from the surface or object with the test defect which is obtained from the sound waves which will be displayed on the monitor screen. in the form of a pulse display which is useful for detecting thickness and whether there are defects or not in the material being tested. The non-destructive testing method is carried out in accordance with standard operational procedures set by the company, both visually and using ultrasonic tests.

From the results of observations of objects that have been inspected using the ultrasonic method, namely measuring the thickness of the Super POD SBF 624, from the good results without any defects being detected, and cleaned in surface condition so it can be said that the machine has shown good effective results and can meet the standards for using tools for the company.

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