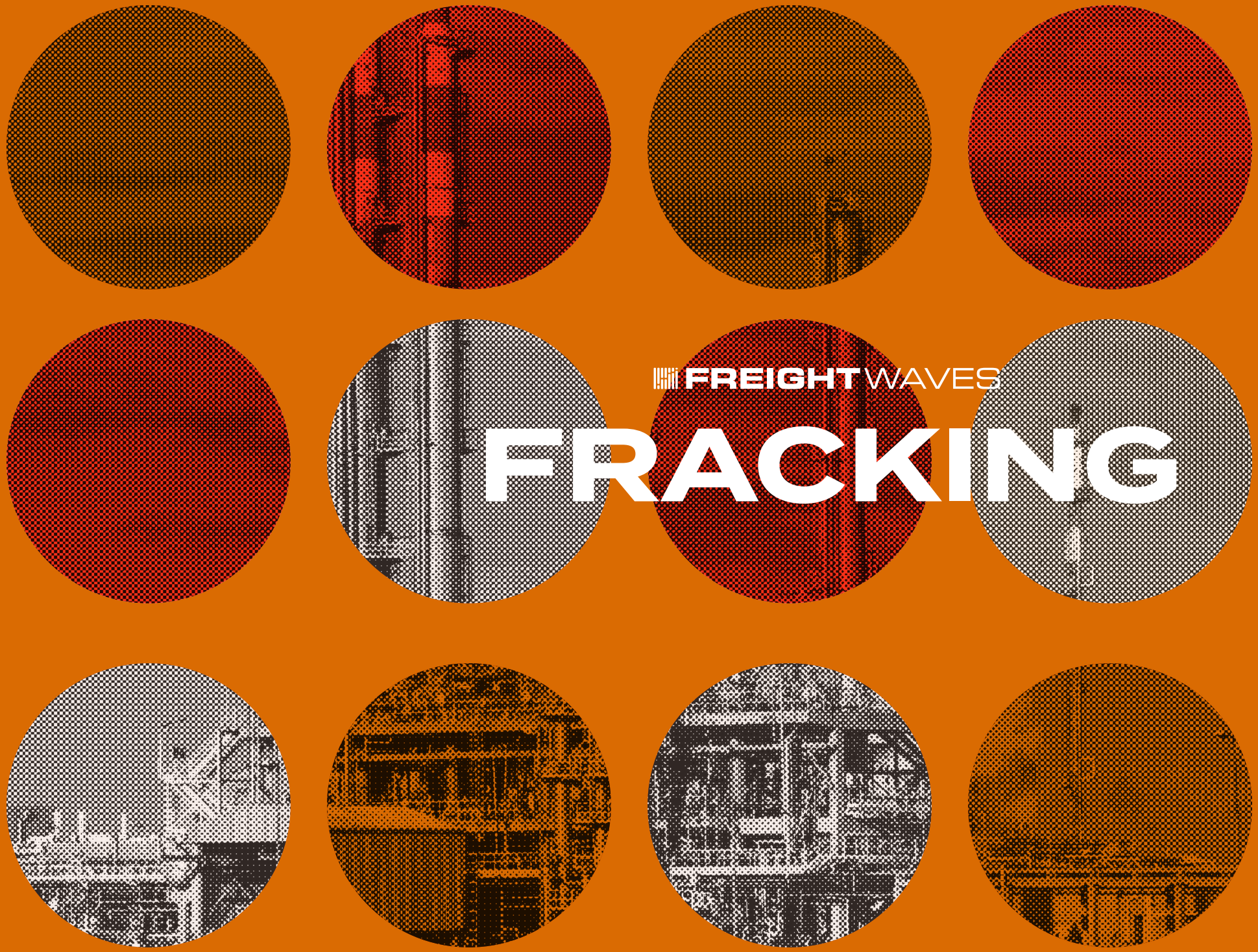
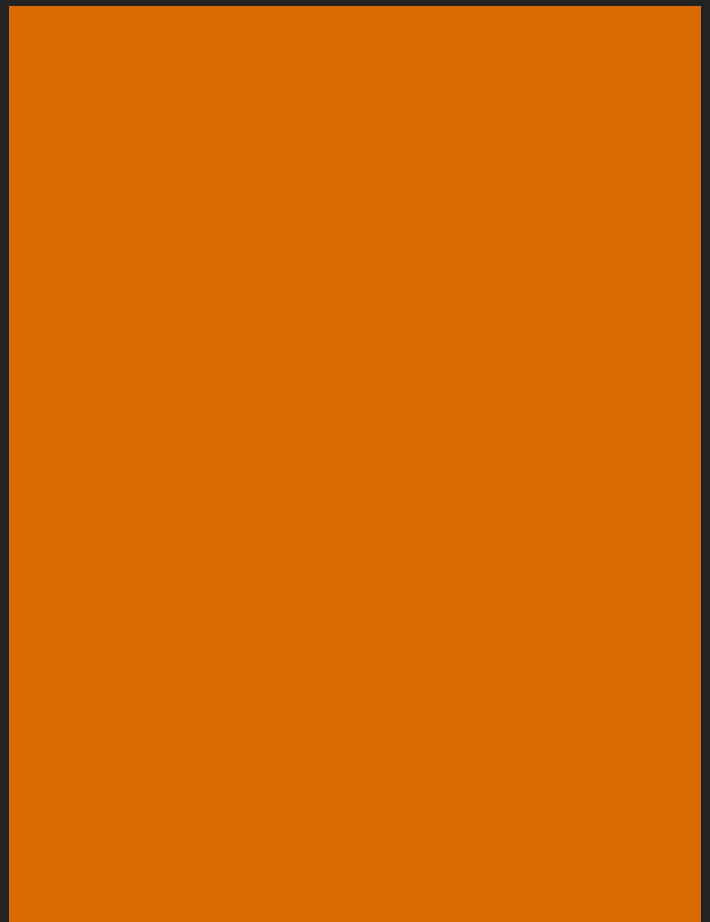

FREIGHTWAVES
FRACKING

01

WITH THE U.S. OIL and natural gas market continuing to boom, and production of both rising, FreightWaves' chief energy analyst Mike Mitchell has written a primer on what happens during the fracking process. Through it, you will be able to see the numerous necessary steps that requires a truck in the process to get done.

02

How do truckers benefit from all this fracturing activity?



TRUCKERS DELIVER SOME of the raw materials needed to perform a fracturing treatment like acid, sand, chemicals, and sometimes the water. Truckers are also in high demand because the service companies need truck drivers to drive their equipment to the location and help rig up their equipment on location. Truckers also benefit from a tight market where oil and gas companies compete with other industries to hire potential drivers to work in the oil and gas industry. Most of the work, however, is delivering sand to the well site. Most fracturing treatment requires over 150 to 400 loads to deliver all the commodities needed for the treatment. The size of the fracturing treatments continues to grow as the lateral lengths of the fracture continues to grow. The number of perforation clusters is also increasing on some of these fracture treatments too. Truckers can follow FreightWaves as the petroleum team is developing content to warn truckers when the market fundamentals are likely to turn from bullish to bearish.


WHAT IS
FRACTURING?

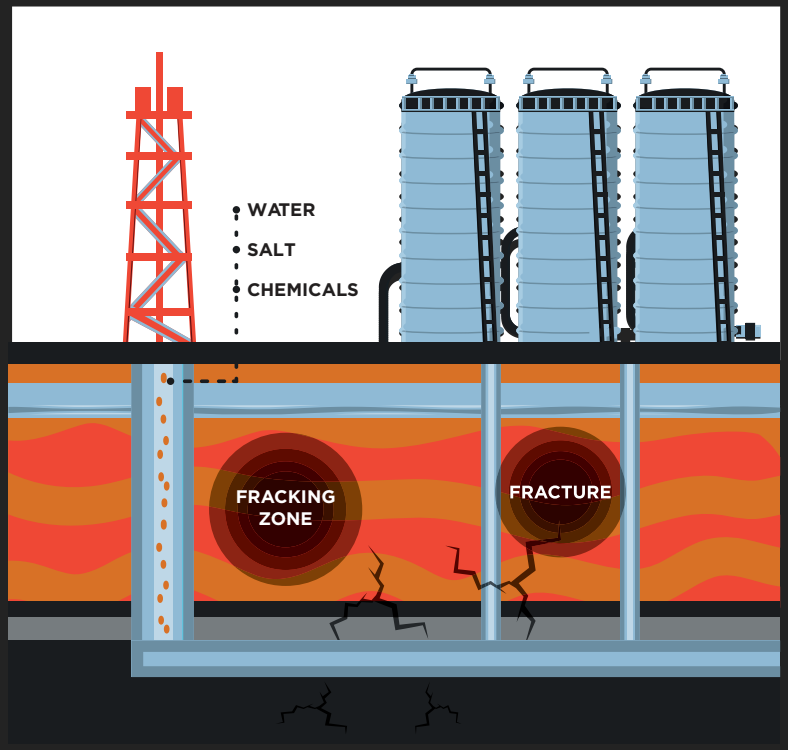
04

HYDRAULIC FRACTURING is a process used to create a conductive pathway for reservoir fluids to flow from the reservoir to the wellbore. Hydraulic fracturing has been used as a process to improve production since the 1940's. Hydraulic fracturing became popular and mainstream when operators figured out they could combine both hydraulic fracturing and horizontal drilling to target low permeability formations in the micro to nanodarcy range. The production from wells with extremely low flow rates was unattractive to oil and gas companies in the early 80's and 90's, but when operators joined the two disciplines together, this started the birth of the shale boom. Horizontal drilling is a technique used in the drilling segment of an oil and gas well. Fracturing is used in the completion process of the well. Fracturing is achieved by using millions of dollars of equipment on location from major and minor service companies or the operating company.

05

Fracturing Operations

THE MAIN EQUIPMENT used on these fracturing treatments are the fracturing pumps, blender unit, chemical additive unit, sand compartments and treatment van. Hydraulic fracturing also encompasses the use of million gallons of water, 2 to 20 million pounds of sand or proppant per well, and the use of specialty chemicals shipped to a location daily.



06

THE MAIN CHEMICALS USED on a fracturing treatment are friction reducers, surfactants, bactericides or biocides, and clay stabilizers. The main chemical used is the friction reducer which reduces friction in the tubular goods or pipes downhole at high pump rates. The surfactants are also used to water wet or oil wet the surface of the rock and relieving the surface tension. Bactericides are used to prevent sulfur-reducing bacteria. Clay stabilizers are used to prevent rock particles in the reservoir from migrating and swelling in the reservoir. These chemicals are either stored in 365-gallon totes or bought in bulk quantity shipped to a location in a tanker truck. The treatment is planned months in advance, so the service company has time to study massive amount of data on the field, the formation, the shale play, and the basin.

07

OPERATING COMPANIES like Shell, EOG, Concho Resources, Occidental, Diamondback Energy, and other operators work in conjunction with service companies like Halliburton, Schlumberger, Baker Hughes, Cudd, Keane, and CJ Energy Services. Some of the data studied consist of reservoir properties such as the permeability of the formation, the porosity of the rock, water saturation, and other rock-related properties gathered from the logging tools used on various wellsite's. This data gives the operator a feel for such things like the ease of flow of the reservoir fluids to the well, the amount of oil and gas stored in the rock, the amount of water likely to produce with oil and gas, etc. The service providers also study rock mechanical properties like poison ratio, overburden stress, Young's modulus, and the in-situ stress of the rock. The engineers at the service company usually get an idea of the amount of sand, chemicals, and water needed to achieve the desired production results from the operating company. Engineers study previous treatments to alter their designs, so the new treatment performs better than the last well producing in the area or basin, with initial production for oil wells averaging 500 to 1,400 b/d of production. Once the treatment is designed, the proposal is distributed to the operator and throughout the service companies, so these companies can start to schedule their equipment on the frac calendar, order materials needed from the wear and tear on the fracturing equipment, order chemicals and acid, and so on.

The drilling and fracturing companies both benefit when the rig count is trending higher, but the fracturing companies have work postponed for a later date when wells enter the DUC column. The supply and demand factors of the market along with other market factors tend to drive market prices on a weekly basis. However, pipeline bottlenecks and low energy prices in basins are a major factor in deciding when wells venture off to the drill but uncompleted category.

08

THE OPERATOR BEGINS to make a completion packet to distribute to all the vendors awarded some contract work on the well or wells on a given location. The service company internally generates a fracturing proposal to distribute to their operations, engineering, supply chain, finance, accounting, HS&E, management, procurement, etc. A couple of days before the fracture treatment begins, the service companies mobilize supervisors to view the location site to determine the size of the location. The supervisor instructs the operating company where to place the 500-barrel tanks that store water on location for the fracturing procedure.

A day before the treatment the crew arrives on location to spot the massive equipment. The crews usually line out multiple joints of pipe rigged up from the fracturing pump to the missile, and the missile to the wellhead. The fracturing crews calculate the amount of pipe needed to transmit the highest rate pumped down the pipes downhole. The crews diligently begin to perform tests on the water, sand and chemicals. In the meantime, the crew runs hoses to the fracturing tanks, the blender, hydration unit, chemical additive unit, and sand from sand terminals arrive on sand trucks to load sand to the sand silos, trucks, or a device called a sandbox. The crew also begin to load and test the chemical pumps and the flow meters, and the crew also distributes the pump schedules detailing the fracture treatment design parameters.

09

Fracturing Pump Schedule: 420,000 pounds of sand pumped on the first stage of 20

Fluid Stage	Rate	Type	Vol.	Cum. (Gals)	Prop. Type	Sieve Size	Conc. (PPA)	Stage (lbs)	Cum. (lbs)
Acid	15	15% HCL ACID	3000	3000					
Pump Down	15	Slick Water	14000	17000					
Break-down	15	Slick Water	5000	22000					
Acid	15	15% HCL ACID	3000	25000					
Pad	90	Slick Water	35000	60000					
Slick Water	90	Slick Water	18000	78000	White Sand	100 Mesh	0.5	9000	9000
Slick Water	90	Slick Water	18000	96000	White Sand	100 Mesh	1	18000	27000
Slick Water	90	Slick Water	18000	114000	White Sand	100 Mesh	1.5	27000	54000
Slick Water	90	Slick Water	18000	132000	White Sand	100 Mesh	2	36000	90000
Pad	90	Slick Water	48000	180000					90000

ON A GEOMETRIC fracturing treatment, the fracturing crew is likely going to use this schedule on all 20 sequences or stages of the treatment. The fracturing crew could also study the rock mechanical data and drilling data to strategically place the perforations based on the strength of the rocks. This process is called an engineering completion design. The pump schedule design would change based on the data analyzed by the service company.

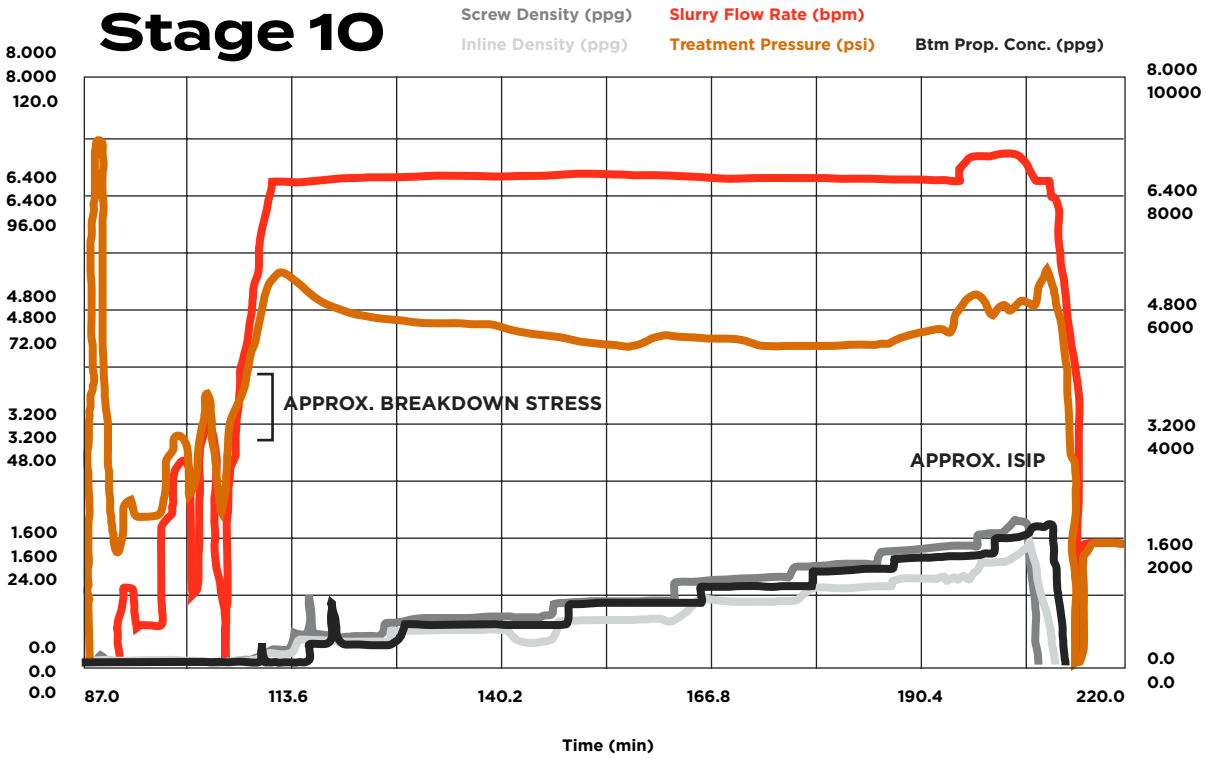
Fluid Stage	Rate	Type	Vol.	Cum. (Gals)	Prop. Type	Sieve Size	Conc. (PPA)	Stage (lbs)	Cum. (lbs)
Slick Water	90	Slick Water	40000	220000	White Sand	30/50	0.5	20000	110000
Slick Water	90	Slick Water	40000	260000	White Sand	30/50	0.75	30000	140000
Slick Water	90	Slick Water	40000	300000	White Sand	30/50	1	40000	180000
Slick Water	90	Slick Water	64000	364000	White Sand	30/50	1.25	80000	260000
Slick Water	90	Slick Water	48000	412000	White Sand	30/50	1.5	72000	332000
Slick Water	90	Slick Water	28000	440000	White Sand	30/50	1.75	49000	381000
Slick Water	90	20# Linear Gel	4000	444000	White Sand	30/50	1.75	7000	388000
Slick Water	90	20# Linear Gel	16000	460000	CRC	30/50	2	32000	420000
Flush	90	Slick Water	14000	474000					

*Continued from page 09

11

Once all the equipment is spotted and safely rigged up, the safety meeting begins to discuss the fracturing procedure and any issue related to the fracturing and wireline procedures. The coiled tubing and wireline crew should have already performed their operations, like shooting holes in the toe sleeve and the reservoir rock, so the fracturing crew can transmit energy to the formation of interest. Once the meeting is over, the crew begins to pressure test the treating iron along with each pump to see if the equipment maintains pressure without any leaks on location. The fracturing crew also tests special pressure related items called the kick-outs on the pump and the pressure pop-off valves. These devices release pressure at the pump or the pop-off to prevent over-pressuring the frac iron, the wellhead and the casing below the surface. If the pressure tests are successful, the fracturing crew is ready to pump water, also called fluid, from a fracturing pit through water pipelines along the road, fracturing tank manifold, equipment hoses and the blender unit. The blending unit receives all the chemicals, sand, and water and delivers them to the fracturing pump suction manifold at 50-85 psi (boost pressure) to open a sunction valve. The transmission of the fracturing pump transmits power to the power end. At the power end of the pump, it converts from a rotating to a reciprocating force through the gears. The crankshaft which is connected to connecting rod powers the pump. The fluid end of the pump is normally either a triplex (3 plungers) or quintuplex (5 plungers). These plungers convert the low-pressure inlet fluid to high-pressure discharge fluid by the plunger stroking or moving from the fluid end to the power end section. This high-pressure fluid travels through a device called a missile, and down the well where the fluid passes through the casing and perforations to fracture the rock at the point of least resistance.

DURING THE FRACTURING treatment, the customer, service supervisor, and engineers are diligently monitoring these variables pump rates, surface pressures, bottom hole pressures, chemical additive rates, water volume and properties, sand rates and volumes. A figure is shown below:



13

THE SERVICE SUPERVISOR is constantly monitoring and adjusting the transmission gears on the fracturing pumps to adjust pump rates to slow down to pump acid and gearing up to reach rates from 50 bpm to 100 bpm (shale fracs) with each individual pump contributing 5 -15 bpm depending on rate and pressures. The crew starts the treatment looking for a breakdown pressure. The breakdown pressure (performed with water) is always less than the pressure that would cause the casing to burst. Once the formation reaches a breakdown point, most fracturing crews usually pump some volume of acid to clean the perforation or holes used to communicate from the formation into the wellbore. The fracturing crew can begin to increase the rate to extend the fracture some distance into the formation to create fracture width, length and height. The crew also begins to pump their chemicals, water and sand into the formation. The crew diligently tries to follow the pump schedule, but sometimes due to pressure issues, the crew might have to change the schedule on the fly to pump the job. At the end of the stage, the sand, water, and chemical are pumped into several clusters into a zone 200-300 feet interval. This procedure is performed multiple times until all the sand and water totaling millions of gallons of water and million pounds of sand is pumped into multiple zones and intervals.

FREIGHTWAVES®

FREIGHTWAVES.COM