Theta Enterprises, Inc.
NEWSLETTER

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RODSTAR's Gas Interference vs. Fluid Pound Options

I recently had a question from a user that is as follows: "When I am running RODSTAR and I change the option as to whether I have a pumped off condition or a gas interference condition there is no change in the predictive surface or downhole card. Why is that? "

The answer follows:

The results of RODSTAR if you select Fluid Pound vs. Gas Interference will be the same if the fluid level is at the pump in both cases. Since the pressure of the gas entering the pump depends on fluid level, this pressure will be the same if the fluid level is at the pump, so basically fluid pound and gas interference would be the same as far as the pressure of the gas entering the pump. However, if you select to simulate gas interference with fluid over the pump vs Fluid Pound (for which the program sets the fluid level at the pump) then the results will be different.

Please keep in mind that when designing a new system, it is best to design it for full pump with fluid level at the pump to ensure that your system can handle this worst case condition. Then, you can make another run to see what would happen if you have fluid pound of gas interference.

How to get a Good match between predicted vs. measured data in RODSTAR

From my experience, comparing predictive versus actual results can be challenging. There are several points to keep in mind to ensure that your comparison will be accurate.

1) Make sure the dynamometer used to measure the dynamometer cards is properly calibrated and zeroed. Otherwise, the measured load can be off.

2) Make sure the fluid level is correctly measured. This may be difficult if the well produces a lot of gas. The foamy fluid in the annulus will give you an erroneous fluid level unless you account for this by depressing the foam first. If you can determine the pump intake pressure using a modern fluid sounder then enter it in RODSTAR for better results.

Also, if you determined the fluid level by setting horizontal lines on the calculated downhole pump dynamometer card in RODDIAG or XDIAG (which does it for you) then consider that this calculated fluid level depends on the fluid specific gravity you entered as well as the pump size. If either of these is incorrect, the calculated fluid level will also be off. If you have a gassy well, you need to reduce the fluid specific gravity the diagnostic program calculates from liquids alone to get a more accurate fluid level. Also, using a more accurate fluid specific gravity in the predictive program will help you get a closer match.

3) Make sure the data about the equipment in the well is accurate. Double check the pump size, rod type, length. and diameters. I have seen mistakes made when changes in equipment were not recorded in the well's file.

4) Adjust the rod-tubing friction in RODSTAR to better match the measured dynamometer card. This is much easier to do by using the overlay capability of RODSTAR to load the RODDIAG or XDIAG file you are trying to match. This brings in the measured dynamometer card and allows you to overlay the predicted and measured cards for easier comparison.

Keep in mind that no matter how sophisticated RODSTAR or any other similar program is, it cannot "guess" how much friction there is between rods and tubing. This varies from well to well and depends on many factors that are not usually known very well (wellbore deviation, paraffin, scale, water cut, dog legs, etc.).

Therefore, even though RODSTAR allows you to have it estimate the rod-tubing friction, it is better to try to determine a more accurate rod-tubing friction by overlaying the measured card on the same plot at the predicted one. Then, adjust the rod-tubing friction for upstroke and

downstroke until you get a good match.

RODSTAR does a good job estimating the average rod-tubing friction (when you select to have the program calculate the rod-tubing friction) based on build-in "experience" based on many actual wells. However, if you have a measured card, you can get closer matches by manually adjusting the rod-tubing friction for even closer results.

Please note that if you have to use significantly higher or lower friction than the calculated average friction, or if you have to use a much higher or lower friction for either the upstroke or the downstroke (more than three to six times higher than the other) then you may have a different problem. Usually, this indicates a load cell that reads too high or too low.

Of course, if you have XDIAG, it automatically detects and corrects the load cell measurement error for you. For any other diagnostic program, you will have to recalibrate or re-zero the load cell and get another dynamometer card.

5) Keep in mind that fiberglass rods are significantly affected by rod-tubing friction. Therefore, it is important to correctly determine the rod-tubing friction for more accurate comparisons.

The overlay capability of RODSTAR discussed above is critical for this type of comparison. Using larger than actual rod-tubing friction will result in lower than actual calculated pump stroke and production rate. Also, the surface loads and polished rod horsepower may be less than for the measured card. This is because the higher than normal rod-tubing friction you entered results in a lot of energy loss along the rod string which results is little energy left at the pump. This lower pump stroke also causes a smaller area for the surface dynamometer card.

When this occurs, you may think that you need to further increase rod-tubing friction to make the predicted loads higher so that they are closer to the measured ones. However, what you have to do in many cases is lower the rod-tubing friction instead. This simulates less energy loss along the rod string which leaves more available energy at the pump. The result is longer stroke and more work done by the pump. This in turn, results in a predicted surface card with more area, higher peak polished rod load, and more polished rod horsepower.

Hint: When trying to match surface dynamometer cards for wells with fiberglass rods, try to also match the calculated pump stroke length.

6) Steel rods are not very sensitive to rod-tubing friction. Therefore, it is a lot easier to adjust the rod-tubing friction for a better match. To increase the predicted upstroke loads, use a larger upstroke rod-tubing friction number. To reduce the predicted downstroke loads, use a larger downstroke rod-tubing friction.

7) Simulate the correct amount of tubing movement for better results. This means that if you see that there is tubing movement from the RODDIAG or XDIAG calculated downhole pump dynamometer card, then you have to simulate the same amount of tubing movement in RODSTAR.

If the tubing anchor is not holding, then you can simply select unanchored tubing. When you select this option in RODSTAR, the program calculates the theoretical amount of tubing movement in inches or centimeters. If this agrees with the amount of tubing movement on the RODDIAG or XDIAG calculated downhole pump card (distance the card tilts) then it will give a better match.

Hint: To simulate partial tubing movement due to the tubing being anchored with insufficient tension, specify that the tubing anchor depth is closer to the surface than it physically is. For example, instead of entering a tubing anchor depth of 8000 feet, you may have to enter a depth of 6000 feet to simulate the correct amount of tubing movement seen on the downhole pump card.

8) Simulate the correct pump condition. If the measured case shows fluid pound or gas interference, then change the pump condition in RODSTAR to match what you see in RODDIAG or XDIAG. For example, if RODDIAG or XDIAG shows fluid pound with 50% pump fillage, then change the pump condition to Fluid pound in RODSTAR with a pump fillage of 50%.

You can do the same thing with gas interference. When you select fluid pound in RODSTAR, the program forces the fluid level to be at the pump. When you select gas interference, you can enter any fluid level you want.

Another thing to be aware of is that RODSTAR cannot simulate a worn pump (leaking traveling or standing valve), pump hitting up or down, worn pump barrel, etc. So, if you have this type of problem, then you will not be able to get a very good match.

To get good matches between measured and predicted results takes practice. The more you do it the better you will get. Please remember that RODSTAR is a predictive program. It simulates the rod pumping system you tell it to simulate and predicts the dynamometer card, torques, etc. In other words, it does what you tell it to do. If you tell it to simulate a good pump but the well has a worn out pump, the results will not agree with the measured ones.

Upcoming schools for 2003:

Rod Pumping Optimization:

Midland, TX: September 8-12
Midland, TX: November 18-20
Calgary, AB: May 5-9
Calgary, AB: Sept. 22-26
Houston, TX: December 1-5

For more information, or to enroll please visit our web site at http://www.gotheta.com

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New CBALANCE Training DVD includes Seven Step Optimization

Theta Enterprises has introduced a new training DVD for CBALANCE that covers how to run CBALNCE, how to use the program with RODSTAR, RODDIAG or XDIAG, and also the Seven Step Optimization process taught in the Rod Pumping Optimization Course by John Svinos. For more information please visit our web site at http://www.gotheta.com