Learn more about Dynamometers

Introduction

In the following essay, the benefits of the Leutert Dynamometer systems shall be compared to other Dynamometer systems on the market. Therefore it will also be referred to descriptions and judgements given at the web side of Lufkin, Inc., Houston, Texas.

There are four systems in use to determine the load of sucker rod pumping systems.

1 The clamp on load transducer
2 The horseshoe load transducer
3 The Leutert Dynamometers using permanently installed spacers
4 A permanent round electronic transducer (doughnut) installed under the polished rod clamp.

As the permanent transducer is only suitable for permanent monitoring systems, we will only discuss methods 1, 2 and 3.

1 The clamp on load transducer

1.1 How it works

The clamp on load transducer is clamped to the polished rod below the carrier bar. It measures a strain in the polished rod, and correlates it to rod stress, and finally to rod load. The rod load is related to the measured longitudinal strain in the clamp on load cell, and is also proportional to the applied strain, the area of the rod, and the Young's Modulus.

1.2 Advantages

- The clamp on load transducer can be installed very quickly.
- It does not require the operator to stand off the well.
- The position of the plunger in the pump barrel is not changed.

1.3 Disadvantages

- „Clamp on load cells have always been questionable as to their accuracy. [...] Part of the problem is that the polished rod was not designed to be the spring element of a precision load transducer. Thus, there are uncertainties as to the Modulus, cross section area and so forth. Also, the surface of the polished rod is typically very rough, abused by polished rod clamps, liners, weathering etc. A very simplified uncertainty analysis can be performed. If each of the above terms in the formula has a 4% uncertainty, then the measured load would have a root-mean-square **uncertainty of 7% (but the actual error could be higher)**. These effects cannot be corrected in a clamp on design due to the uncertainty of the material being measured." (Lufkin)
- „Another uncertainty with the clamp on is the zero offset. The transducer is usually placed on the polished rod, which already has an unknown load on it. [... The] measured 'load' needs to be adjusted to a 'known' load." (Lufkin)
- The clamp on load cell requires a separate displacement transducer.

2 The horseshoe load transducer

2.1 How it works

„A horseshoe load transducer is installed between the pumping unit carrier bar and the permanent polished rod clamp. To install the horseshoe, a temporary polished rod clamp is positioned on the polished rod above the stuffing box when the polished rod is at the bottom of the stroke. A temporary knock-off block is located on the stuffing box as the polished rod with the temporarily installed clamp is on the down stroke. Also on the down stroke, the motor is turned off. The momentum of the system causes the polished rod to continue downward until the temporarily installed polished rod clamp comes in contact with the knock-off assembly. The pumping unit brake is set when the polished rod is at the bottom of the stroke. This causes the permanently installed polished rod clamp that normally rests on the carrier bar to be several inches above the carrier bar. The [... horseshoe load transducer] is positioned into the free space between the carrier bar and the permanent polished rod clamp. The pumping unit brake is released causing the load to be transferred from the knock-off block to the carrier bar. Then the knock-off block is removed and the well is started again. Dynamometer tests can be performed after the well has stabilized or as desired."

2.2 Advantages

- The horseshoe load transducer measures the load directly, unknown or inaccurate physical properties of the polished rod have no influence.
- The zero offset is known.

2.3 Disadvantages

- The position of the plunger in the pump barrel is changed. „For this reason, the polished rod transducer analysis may be more representative of actual well performance than an analysis using a horseshoe transducer that raises the plunger in the pump."
- **If a pump is stopped** it will take a significant time until the subsurface conditions (fluid level and flow rate) get stabilized again. Leutert found out that **it takes up to one hour till the subsurface conditions recover**. Not every operator wants to wait that long. Additionally a measurement taken immediately after the start up of the pump, will NOT be representative of normal operation of the well and the results of the analysis can be VERY wrong.
- Another effect of stopping the pump can be the build up of paraffin, or sand problems, causing increased friction, or malfunctioning of valves.
- The horseshoe load transducer requires a separate displacement transducer.

3 The Leutert Dynamometers using permanently installed spacers

3.1 How it works

Each pumping unit to be logged will be equipped with a set of spacers (attachment gear) fitted to the polished rod above the hanger bar between the two wire ropes. Once fitted, the attachment gear remains as a permanent fixture to the pump. The Leutert Dynamometers DYN / DYC can be installed within minutes by slipping the instrument into the previously installed spacers. Please also view attached data sheet.

3.2 Disadvantages

- Each Pumping unit to be logged must be equipped with a set of spacers.

3.3 Advantages

- The Leutert Dynamometers measure the load directly, because it picks up the load hydraulically, and unknown or inaccurate physical properties of the polished rod have no influence.
- The zero offset is known.
- The plunger setting depth remains unchanged to the normal operation.
- The instrument can be fitted quickly and without interruption of the pumping process.
- Its installation is so simple that it can be fitted without special training by any field operator.
- This does not only save overall operation time, and allows many more wells to be measured in a certain period of time, but the main advantage is the fact, that **the subsurface conditions of the system do not change because the pump never stops**.
- The Leutert Dynamometers incorporate both, the load transducer and the displacement transducer, in a compact system, whereas the horseshoe load cell and the clamp on load cell require a separate displacement transducer. Therefore the Leutert Dycomaster system has one cable only to connect the transducers to the Data Acquisition Unit, making the complete system safer to operate and less susceptible to cable malfunction.

- **CE- and ATEX-certfied**

4 Summary

The Leutert Dynamometers combine the benefit of the two competitive systems described before, without having any of the disadvantages of those systems. The Leutert Dynamometers do not require to stop the pump, preventing the build up of paraffin, or sand problems, which causes increased friction, or malfunctioning of valves. As a summary we can state, that the Leutert Dynamometers are the most accurate systems for the acquisition of dynamometer data. Therefore they have been the favoured instruments of most international oil companies for many years.