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RESOLVING LIQUID MEASUREMENT DIFFERENCES

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Before we begin a discussion resolving liquid measurement differences, let's take a quick and very basic look at what measurements are, and why they are so important to our industry. Webster's defines measurement as: 1) the act or process of measuring; 2) a figure, extent, or amount obtained by measurement. Mr. Webster could not have given us a better description of what we do as petroleum measurements technicians. Our job is to obtain an accurate amount, or measurement, of a liquid using a process of measuring. The process used could be hand gauging a tank to determine liquid level, or using a turbine meter in a pipe line system to determine the amount of a liquid moved. We often say that measurements are the cash register of the industry. Let's take a closer look at what is meant by measurements being a cash register.

Show Me the Money

When you purchase an item from your favorite retail store you check out that item by giving it to a cashier who uses a cash register to record your purchase and charge your account, or take your money. This process is performing several tasks that are necessary to run a retail business:

1. It counts the number of items sold so they can be reordered and the shelves restocked.
2. It charges a fee for each item purchased and gives a total of all items purchased at that time.
3. It could determine which account should be charged for the items purchased.

Do you realize that a measurements technician is performing the same tasks as a retail cashier? During the course of a day in the life of a measurements technician the technician:

1. Provides inventory information such as product brought in, product moved out, and product in storage.
2. Charges are generated based on the fees levied on the amount of product measured for storage, transport, or being sold to someone else.
3. Through the ticketing procedure, it is determined who is to be charged and for what amount of product.

As one can see from this simple comparison, measurements are truly the industries cash register.

Custody transfer

When working in measurements you will often hear the term "custody transfer" used. This is the point where one company hands off the product to a second company. One example could be: one pipe line company is delivering product to a second pipe line system for distribution. This amount of product is measured and ticketed to the second pipe line

company and fees are charged on the amount of product shown on the ticket. A simple formula would be, custody transfer is: the amount of fluid measured multiplied by the tariff would equal the fee charged. The money made is profit and this affects the company bottom line. Suddenly measurements become very important to everyone since it has a direct effect on money made.

Now we can see why the resolution of measurement differences is so important to resolve, and why the numbers used in measurements need to be accurate. Let's now take a look at who is involved in measurements.

Who's Responsible for this Mess?

Engineers create the tools we use in measurements and make our jobs easier and much more accurate. Managers and supervisors make sure our work environments are safer and that we have the tools to do our job well. Vendors help us by supporting the equipment that is used in the trade. All of these people are very valuable to having good measurements programs but the one person who is ultimately responsible for the day in and day out measurements is the field person. The gauger, operator, or the technician in the field on location is the one who shoulders the responsibility for good measurements. To be a good measurements person one must be well trained and know how to use the many resources that are available to them. One must ensure that the most effective tools and methods are being used. The good measurements person must be able to recognize that a problem exists and be able to determine the cause of the problem and then resolve it. Now we are ready to move on to the types of measurements and their associated problems.

Types of Loss

There are two types of loss that you will be dealing with:

1. Actual Loss
 - Theft
 - Release or leak
 - Evaporation
 - Operational procedures
2. Apparent Loss
 - Transposition of numbers
 - Incorrect data
 - Table errors
 - Software or programming errors

Actual loss is often hard to prevent and it may take an engineered solution to solve.

Apparent loss is caused by human mistakes and can be prevented. It is good to have some sort of redundancy or self check built into your work and ticketing procedures and this will help prevent mistakes leading to losses.

Types of Measurements

There are two types of measurements that we will look at in this discussion. They are

dynamic and static measurements.

Static Measurements

Static measurements are obtained by using a weighted/mass system and can be as complex as a remote gauging system for tanks, or as simple as an operator using a hand line to gauge a tank. Static measurement accuracy depends on:

1. Condition of equipment. Make sure your tools are clean and in good repair.
2. Temperature of liquid. Temperature can greatly affect volume calculations.
3. Correct tank strapping charts.
4. Sediment or foreign matter in tank.

Dynamic measurements

Dynamic measurements are accomplished by using a metering device. A metering device could be one or multiples of:

- Turbine meter
- Positive displacement meter
- Helical turbine meter
- Ultrasonic meter
- Coriolis meter

Dynamic measurement accuracy is affected by different factors depending upon the type of device used. Let's take a look at some of the more common problems found.

A. Turbine meter: what would make a turbine meter factor change?

1. Factor increases
 - Rotor blade damaged or missing
 - Mechanical problems causing drag
 - Missing or damaged pulse generator pick-up or button
2. Factor decreases
 - Trash hung on rotor
 - Trash creating blockage in straightening vane

B. Positive displacement meter

1. Meter factor increases with meter wear which creates drag
2. A faulty mechanical compensator may cause the meter factor to increase or decrease

C. Meter prover (for this discussion we will be concerned with conventional uni-directional and bi-directional provers)

1. Critical valves associated with a prover

- Leaking prover inlet valves will cause a higher factor
 - A leaking prover diverter valve will cause a lower factor
 - A leaking interchange seal or four-way valve will cause a lower factor
2. Problems associated with the prover ball (sphere)
 - An underinflated ball causes slippage and a lower meter factor
 - An overinflated ball causes erratic sticky movement which causes poor factor repeatability
 - A deflated ball will not activate detector switches and will cause a higher meter factor
 3. Detector switch problems are usually caused by the switches mounting becoming loose or switch mechanical failure. If a detector switch is relocated on the prover piping or is replaced there must be a follow up water draw.
 4. Other prover problems which would cause a lower factor
 - A high prover temperature
 - Air or gas intrained in the liquid
 5. Prover problems that can cause higher factors
 - Prover temperature is too low
 - Fewer meter pulses being received by the counter

We have dealt with measurements hardware and it's problems now let's take a brief look at how the characteristics of the liquid being measured affects the factor.

1. A liquid with a high viscosity will give you a more resolute factor due to less slippage in the meter
2. A liquid with a lower viscosity will cause an increase in slippage within the meter and you will see an increase in the factor

Conclusion

We have seen that the resolution of measurement problems can be very simple or very complex. We must remember that ***routine is the enemy of focus***. And as we go through our daily routine it is easy to become complacent and inattentive especially when working with a large quantity of numbers. Accuracy is imperative to good measurements. Always take your time and double check your work because it will cost you less time than if you have to go back and trouble shoot a problem. Never assume that your numbers are going to be correct. Remember that to ASSUME something may make an ASS out of U and ME. Always be sure that your numbers are good and your equipment is operating properly before contacting the other party involved. Courtesy and teamwork go far when dealing with others. Remember that you are representing your company and the ethics of that company are demonstrated through your actions.