The Lease Pumper's Handbook

Chapter 12
Gauging and Analyzing Daily Production

Section C

ANALYZING DAILY PRODUCTION

When a stock tank is gauged (Figure 1), the anticipated production level may be detected, or the level may be long (more oil than expected) or short (less oil than expected). Usually if the production is short or long, the pumper's next action is to re-gauge the tank.

Figure 1. Gauging daily production of crude oil.

C-1. Problems with Short Production.

If the second gauge confirms that the tank is short, the pumper must investigate the reason for the loss. The four potential sites of loss are:

- At the tank battery.
- From a broken or plugged flow line.
- At the well surface.
- Downhole.

At the tank battery. Even if it is suspected that production was lost because a well failed to produce as scheduled or because of a problem downhole, the logical place to start is at the tank battery after re-gauging. This should only take a few minutes to check out. A visual inspection upon arrival at the property will have already confirmed that there are no leaks, so if the problem is at the battery, it must be in a vessel. Potential problems include:

- **Oil in the separator gas line.** There are many causes that may prevent separators from functioning correctly. If a float has broken off in the separator, the total emulsion may go down the gas line. This can be determined in seconds by observing the sight glass and feeling the action of the float to dump valve linkage or by force dumping the pneumatic valve control. A diaphragm control valve can develop a gas leak. Mud daubers (small wasps) can plug the vent holes in pneumatic valve breathing holes with mud if the holes do not have the correct screened fitting.
- **Oil is trapped in the heater/treater wash tank.** The oil level sight glass on the heater/treater should be checked and the gun barrel thiefed. If the oil dump line from these vessels plugs or an oil valve is closed, the accumulating oil will force water down the water disposal line until it empties all of the water from the vessel. The oil will then go into the disposal system or to the pit. Water accumulation

should be checked in both of these places. A glance at a functioning gauge glass will usually confirm or reject the possibility of a heater/treater problem. Sight glasses that are allowed to plug and become non-functional will cause problems in production analysis. They must be kept fully open and functioning correctly.

- **Paraffin.** Wax can accumulate at the oil/water interface level in the gun barrel and seal off at the edges. This seal prevents proper oil/water separation action and forces all liquid production out the water disposal line. A steamer or hot oiler and chemical treatment is usually required to melt the paraffin and force it into the produced oil tank. This is one of the many reasons that a gun barrel is periodically checked for performance and must have a satisfactory ladder or walkway access.

The water disposal system should be checked for excessive water accumulation. If water disposal is metered, a reading comparison from the past few days will reflect excessive water disposal. If these are not the source of the problem, other systems unique to the battery should be checked.

A flow line has broken or become plugged. These lines are normally inspected on a regular schedule and are rarely the source of the problem. However, to be thorough, they should be checked.

If the line is on the surface, it should be *walked*—that is, the lease pumper should walk along the line checking it for leaks and plugged sections, occasionally tapping the line with a small hammer to locate plugs. The sound is much more solid when it contains no gas. Lines under roadways occasionally become plugged. Use of a conduit tube around the pipe can reduce this problem.

At the well surface. At the well, the problem can be on the surface or downhole. Since it is much easier to check surface equipment, troubleshooting should begin here. Surface problems at the well include:

- **A well was accidentally turned off.** This is a fairly common and simple mistake, especially among inexperienced pumpers. By producing the well for a short time and gauging late, much of the shortage can be made up the same day that it occurs.
- **Electrical failure.** Electrical problems are common. The pumping unit must be turned on to check for electrical problems. This repair can be as simple as pushing the reset button or replacing a fuse or as serious as changing out a motor. Fuse problems are often caused by using incorrectly rated fuses. Most automatic boxes can have more than one fuse. Occasionally, field mice and other animals can cause problems, such as chewed wiring, if the motor vents are not covered with hail screen.

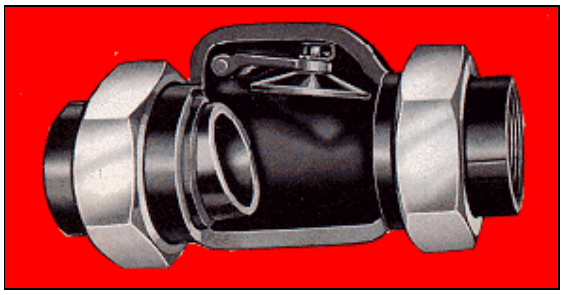

Figure 2. Forged steel Catawissa swing check valve.
(courtesy of Dandy Specialties, Inc.)

- **A casing check valve may have failed to close properly.** An example of a check valve is shown in Figure 2. If the casing check valve fails to close properly, the produced liquids may be circulating back to the bottom of the well through

the annulus. If this occurs, the bleeder will have exceptionally good pump action, but the well will produce no oil to the tank battery. Often a simple cleaning of a check valve will correct the problem. To test the possibility of check valve failure, close the casing valve for two hours with the well pumping, then reopen it. If a casing check valve also fails at the tank battery, it is not unusual for the production from other wells to flow back and be lost back into the formation.

- **A leak in a casing check valve on the tubing will give a similar indication.** If the check valve is leaking, the lease pumper should re-gauge the stock tank for a production increase.
- **A valve accidentally left closed.** As the gas pressure builds up in the annular space and in the formation close to the well, the well will stop producing oil. This is most likely to happen when procedures have been done at the well that required valves to be closed, such as treating the well with chemicals that were circulated down the annular space.

When a closed valve is reopened, it should be done very slowly. The pressure may build up to several hundred pounds and this sudden surge to the tank battery can rupture an atmospheric tank. The valve should be slightly opened and allowed to bleed off for a period of time. Opening should be completed only after the pressure has bled off. A valve should never be placed to the wide open position suddenly.

Sometimes the failure will be the result of a combination of one or more of these problems.

Downhole. Some downhole problems that lead to a loss of production, such as a worn-out pump, parted rods, or a hole in the tubing, will require a well servicing job. Several other problems, however, can be solved from the surface without a pulling unit. Common problems include:

- **Pump valve not seating.** If the problem is in the pump, it may be determined by first opening the tubing bleeder valve while the unit is pumping. The pump may have trash under the standing or traveling ball. The pump should be lowered by raising the rod clamp above the pumping unit carrier bar and then started. This will allow the downhole pump to start bottoming out. With some wells this procedure may be necessary to stimulate the pump back into action. With wells on engines, pump tapping can be started by merely increasing the RPM if it is spaced to meet this need.
- **Gas lock.** Pumps are occasionally improperly serviced by supply companies. Common problems can include use of a barrel that is too long or a pull rod that is too short. The two valves are then too far apart when the pump is collapsed or pushed all the way in. This can result in gas being trapped between the valves. Even when the rods are lowered to make it tap, the only thing that will break the gas lock is to either wait until the casing fluid builds up enough hydrostatic pressure to override the problem (which may require several days) or to unseat the pump to lower the hydrostatic head inside the tubing. Neither of these is a good solution.
- **Salt bridges downhole** will cause a problem similar to closed valves with a resulting loss in production. To solve this problem, the lease pumper must drop a load of fresh water down the annulus. This is very dangerous as fresh water seals off some zones.

- **Plugged casing or tubing perforations can prevent oil from entering the well.** The casing can also fill become *sanded up*—that is, filled with sand from the production zone.
- **A worn or failed pump may lead to production losses.** Checking the lease record book may confirm this. The dates of the last several pump changes should be checked. Pumps will usually last a similar amount of time for a given well, so by checking how long the pump has been in use, the problem can be isolated as it begins to develop and before total failure occurs.
- **Tubing can split** due to a number of reasons. Sometimes a split in the tubing will seal as pressure is removed, only to open again when the tubing is pressurized, allowing fluids to escape through the split.

Some downhole problems, such as a worn pump or split tubing, may be indicated by a failure to develop pressure in the tubing. To check for this problem, the pump is run to place pressure on the tubing. The test is simple, but it requires common sense and caution. The proper method is as follows:

1. Place a pressure gauge in the pumping bleeder valve.
2. Close the tubing wing valve to the tank battery.
3. Turn the pumping unit for one revolution.
4. Turn the pumping unit off.
5. Check the gauge pressure.

   CAUTION: Never look the gauge directly in the face for safety reasons.

6. If no pressure develops, repeat the procedure.
7. After pressurizing the column, let it sit for several minutes to allow time to note pressure changes.

The bleeder valve and other surface connections may be standard pressure fittings, so extreme care should always be exercised when pressurizing a wellhead. The gas column in the tubing determines how quickly the pressure comes up. If the tubing contains a full column of liquid, the pressure will escalate rapidly. On shallow wells after pressure has been pumped up on the wellhead the rods will not fall, and the pumping unit bridle loses contact with the rod clamp.

If the unit does not develop pressure, the rod string may need to be lowered or other tests run. The problem should be reported to a supervisor before a well servicing company is called.

If the pump has good pump action but still does not produce fluid, a problem such as split tubing is likely.

Chapter 17 discusses downhole problems in detail.

C-2. Problems with Overproduction.

If the oil gauge is higher than expected, the pumper should be pessimistic. While there is a very remote possibility that a water flood project has caused an increase, it is much more likely that there is a production problem. For example, there may be a plugged water leg line in the wash tank or heater/treater or possibly a closed water valve. If thiefing a tank confirms that oil is being excessively produced, there is almost certainly a plugged water drain line causing water to rise in the wash tank or heater/treater, thus flushing excessive amounts of oil to the stock tanks. Problems such as this normally occur in three-stage vessels that utilize a water leg.

A quick check of the gauge glasses in the heater/treater, a Kolor Kut test on the gun barrel, and a quick look at the water disposal system will usually indicate the location of the problem in a few minutes.

The problem must be solved quickly or all water being produced from the wells will flow into the stock tank. The lease pumper should make sure that stock tanks have enough room so that excessive oil production cannot overflow onto the ground.

After the problem has been located and solved, the correct amount of oil and water will need to be circulated back through the heater/treater so the system can be re-balanced.

Determining if the overproduction is oil or water. A good pumper who takes care of the lease well should always know how much BS&W is in every tank. The last run ticket provides the reading as well as tests before sale of the oil. To determine if the overproduction is oil or water, the pumper should run a quick Kolor Kut test to determine the bottom condition, thief the bottom of the tank, or if in doubt do both. Both of these tests can be performed in less than 15 minutes.

If a heater/treater or gun barrel is at the site, the excess production will probably be oil, and the tank battery is entering an unbalanced situation that must be brought back into balance. The pumper should check all the sight glasses for level changes.

When the tank battery is still in balance. If all systems are known to be functioning normally, then the oil must have come from the formation. The common causes for wells to overproduce are as follows:

- **Increasing pumping unit time.** Pumping unit time can be increased and a small amount of oil can be gained for a few days, but production will return to the original level with the wells pumping longer. Pumping time costs money. However, if the pumper is overproducing the wells, cutting back the pumping time will cause a slight reduction in production for a few days. If the pumping time is sufficient, the wells should be produced efficiently in consideration of time.
- **A well has broken a gas lock.** When a pump breaks a gas lock, it will produce additional oil until the annular space has been emptied of liquid, then it will return to the original production level.