

“Liquid or gas?”

Most inflatable packer manufacturers recommend the use of water for packer inflation rather than air or gas – although gas systems are certainly still around. An exploration of why this is the case is a good way of reviewing critical issues in packer design and operations.

The four big differences between water and gas for our purposes are, firstly, that water does not compress like gas; secondly, that water is often down the hole you have drilled; thirdly, rubber is permeable to gas and fourthly, the logistics of water supply and management are easier than with gas.

These characteristics have the following effects:

- The first compressibility effect is *dynamic sealing*. Push in at a point on a water filled packer, the volume does not change and the effect is to increase the pressure across the remainder of the packer – which makes for a better seal. On the other hand, a gas inflated packer will only provide a seal as long as the it's inflation pressure is well above the differential pressure.
- Due to the dynamic sealing effect of liquid inflated packers, they can often be inflated at lower pressure than the expected injection pressure. This can be very useful, for example when testing in soft formations which may yield under a higher inflation pressure
- As water volume remains constant, liquid volume measurements can be used in conjunction with inflation pressure to estimate hole size and thus avoid over-inflation in washed out or oversize holes. Conversely, gas inflated packers give very little indication of over inflation and allow a packer to continue to expand in the event of formation yield. Therefore water inflation reduces the potential for accidentally bursting a packer.
- When working in deeper applications under high groundwater conditions, the surface gas pressure required to simply overcome the static head (of water pressure) can be very high. This leads to high consumption of gas since cylinders can only be used down to the static head pressure, whereas the hydrostatic head from the water in rods above the groundwater level actually reduces the incremental pressure of water at surface that is required to inflate the packers.
- Rubber is permeable to gas, which leads to two unwanted effects when inflating a packer with gas. First, in a long term application, for example in a monitoring well, you have to keep topping up the gas pressure owing to gas loss through the rubber. Second, compressed gas becomes absorbed in the rubber, so that, when the packer is deflated and retrieved to the surface this gas is desorbed and causes local delamination of the rubber and reinforcement carcass – it's the same phenomena divers have with the “bends”, but with packers the effect is evidenced by relatively large balloon style “bubbles” appearing on the rubber surface.

- Experienced operators will testify that hundreds of metres of gas inflation line is not a desirable operational feature – but with water you can sometimes use the drill rods and mud pump - thereby simplifying what you need on site.
- In modern mining, Health and Safety is all important – but has a cost of compliance. Being able to work without high pressure gas on site removes one such overhead cum management distraction. You could also avoid the logistical problems of getting gas bottles to remote sites and/or finding you have incompatible gas bottle connections.
- Finally, water is plentiful, non-polluting, easily and cheaply measured and pumped. To some extent the same may be said for gas except that it's usually not so readily available – especially if you're working in any remote location in a country with variable standards of supply.

Of course, there are some disadvantages with water – but they can usually be mitigated:

- If working in a relatively dry hole the hydrostatic head of the water in the inflation line can slow, if not totally frustrate, packer deflation – unless you have a dump valve on the packer to drain that “head”.
- Working in permafrost conditions makes freezing a real probability – but you can add antifreeze or use brine.
- If using a mud pump and drilling mud, it should be clean and not have a level of debris in it that will clog instruments and tools. Well, “clean mud” might be an oxymoron to some – but most professional drillers do know what this means!..
- If the temperature of the water fluctuates the water pressure and volume can drop below or exceed operational thresholds, more so than with gas – but if that is likely some form of compensator will resolve this.

The advantages of inflating with water are exemplified in IPI's Standard Wireline Packer System (SWPS), a tool for permeability testing in conjunction with wireline coring activities. Traditionally such packer testing is performed with gas inflated packers with all the drawbacks that entailed. The new SWPS tool removes any need for gas inflation or any inflation tube at all since it uses the drill rods for water inflation. This simplifies the handling and mobilization requirements for a test program while also providing all the inherent advantages of water inflation, including faster operational cycles.

SWPS has been successfully used in such remote places as the Burundi / Tanzanian border, Northern Canada and Outer Mongolia, as well as the relatively more accessible areas in Australia, South Africa etc

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For more information on inflatable packers visit www.inflatable-packers.com.au