TAM
UNDERGROUND GAS STORAGE

Natural gas is stored in natural or artificial spaces in underground geologic formations.

• UG Storage description, needs & types
• Typical well designs
• Wellbore applications
• TAM solutions
• Advantages of Inflatable Packers, set in open hole/casing/corroded casing

TAM INTERNATIONAL
Inflatable and Swellable Packers

ISO 9001: 2008 Certified Company
Salt Cavern Underground Storage

Salt caverns have been used to store hydrocarbons such as liquefied petroleum gas, propane, butane, natural gas, crude oil, and more, since the 1940’s.

Benefits

- Seasonal balancing
- Efficiency
- Coverage of consumption peaks
- Support of transmission flexiblity
- Safety reserves

Features

- Cavern storage consists of artificially created cavities.
- These can be salt caverns or abandoned coal or other mines, as well as spaces established specifically for the purpose of gas storage.
- The main advantage consists in easy management of gas flow and high injection and withdrawal capacity.

Other Types of Underground Gas Storage

Depleted Gas Reservoirs:

- Exploited deposits of crude oil or natural gas.
- Gas is stored in small pores and cracks in solid but porous and permeable rocks.
- The place in the deposit, which was opened by exploitation of crude oil or natural gas, can be re-used for gas storage.

Aquifers:

- Aquifers are underground porous, permeable rock formations that act as natural water reservoirs.
- May be reconditioned and used for natural gas storage.
- Least desirable and most expensive type of natural gas storage method.
How are Caverns Formed?

Typical Applications in Salt Dome Storage Wells

- Temporary plugging (for logging, wellhead change out, etc.)
- Off-bottom cementing

Operational Concerns

- Temperature fluctuations
- Good casing cement bond requirement
- Affordable solutions

Cross-section through typical oil & gas field with salt dome.
Wellhead Repair/Casing Integrity Testing/Corrosion Logging with Retrievable Bridge Plug Run on Tubing.

Stage Cementing with Packer and Port Collar.

Fig. A:
1. Run casing as required.
2. Install packer and port collar as required.

Fig. B:
4. Drop ball down to bridge plug.
5. Pressure up to inflate the bridge plug.
6. Pull up 10,000 lbs to confirm the bridge plug is set.

Fig. C:
7. Drop larger ball down to hydraulic release.
8. Pressure up to activate release mechanism.
9. Pick up to disconnect from bridge plug and pull out of hole.

Fig. D:
10. Make up TAMCON retrieval tool, BHA to work string.
11. Run in hole circulating as required.
12. When 33 ft (10 m) above the bridge plug, stop and reduce circulating pressure.
13. Move down slowly to tag bridge plug.
14. Set down 10,000 lbs to latch bridge plug.
15. Take an overpull of 10,000 lbs to confirm latch.

Fig. E:
16. Apply 8 turns of right hand rotation to deflate bridge plug.
17. Wait 20 minutes for bridge plug to fully deflate.
18. Pull out of hole, circulating as required.
Casing Cementing with TAMPLUG in Open Hole then Deflated and Dumped on Bottom.

**Fig. A:**
1. Make up TAM bridge plug, BHA to work string.
2. Run in hole, circulating as required.
3. When on depth take note of up and down string weights.

**Fig. B:**
4. Drop setting ball down to fill sub.
5. Pressure up to inflate the bridge plug.
6. Pull up approximately 10,000 lbs to check the bridge plug is set.
7. Set down 10,000 lbs on the bridge plug and put left hand torque on the tubing. Pick up slowly maintaining the torque and disconnect.
8. Pull out of hole, circulating as required.

**Fig. C:**
9. Dump sand on top of the bridge plug.
10. Run and set 7" casing and perform cement job as required.

**Fig. D:**
11. Run in hole and drill out shoe track and excess cement above bridge plug.
12. Run in hole with TAMCON retrieval tool BHA.
13. Tag the sand plug placed above the bridge plug, circulate and wash out sand plug on top of bridge plug.
14. Latch onto top of bridge plug.
15. Pressure up to shear out solid choke and allow equalization to take place.
16. Apply eight turns of right hand rotation to deflate bridge plug.
17. Wait 20 minutes for bridge plug to deflate.
18. Run into cavern.
20. Hydraulic off and drop bridge plug in cavern.

Corrosion Survey with Single Set Retrievable Bridge Plug Set in Casing on SlikPak and Retrieved on Wireline.

**Fig. A:**
1. Rig up TAM BHA on deck and perform surface tests.
2. Rig up equipment in lubricator.
3. Pressure test lubricator.
4. Run in hole, speed will depend on tools used and well conditions.
5. Pull test and record weights every 1,000 ft and at setting depth.
6. Correlate as required.

**Fig. B:**
7. At setting depth, flag wireline and remain stationary for 30 minutes to activate inflation pump and inflate bridge plug.
8. Pick up to determine if bridge plug is fully set and running tool released.
9. If running tool is still not released take an overpull to shear pins on the pressure intensifier.
10. Mechanically intensify inflate pressure until running tool releases.

**Fig. C:**
11. Pick up to confirm release.
12. Run in and tag bridge plug.
13. Pull out of hole.

**Fig. D:**
14. Fill and pressure casing with fluid.
15. Carry out casing corrosion survey as required.

**Fig. E:**
16. Make up JDC pulling tool BHA.
17. Run in hole to top of bridge plug.
18. Tag bridge plug and jar down to engage the fishing neck and to shear out equalizing choke, and allow fluid to drain from packer.
19. Jar up to deflate the bridge plug. Wait 30 minutes.
20. Pull out of hole slowly.
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