

CUTTINGS RE-INJECTION

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As environmental legislation becomes tougher, exploration and producing companies are forced to use modern methods of disposal of drilling waste. There are many methods, but the most interesting is the Cuttings Re-Injection. Cuttings Re-injection is the removal of drilling waste by pumping them into the formation. Recently, this method is especially attractive for oil and gas companies, as it has a number of advantages, such as:

1. Zero discharge: it means that nothing is left on the surface;
2. Total operator control: as the re-injection is used at the drilling site, operators can fully control the whole process of operation.
3. Worldwide application: CRI technology can be used anywhere in the world; CRI operations were conducted in the North Sea, Africa, Asia, Alaska and so on.
4. Favorable economics: CRI technology is often the most cost-effective.

Drilling waste are injected into the formation through an engineering-determined injection well. They are injected at a pressure high enough to continuously fracture the formation. When injection stops the pressure decreases, the slurry flow stops, and the solids are trapped in place in the induced fractures.

Cuttings Re-Injection can be performed with drilling or production operations at the same time using one of the well annuli. A dedicated injecting well can also be utilized by collecting materials from different wells and injecting them into the designated well. The three most popular injector options are shown in Figure 1. The operator selects a required option on the results of engineering research.

1. Annular injection
(drill/produce and inject simultaneously)

2. Tubing injection
(existing redundant well)

3. Tubing injection
(dedicated injection well)

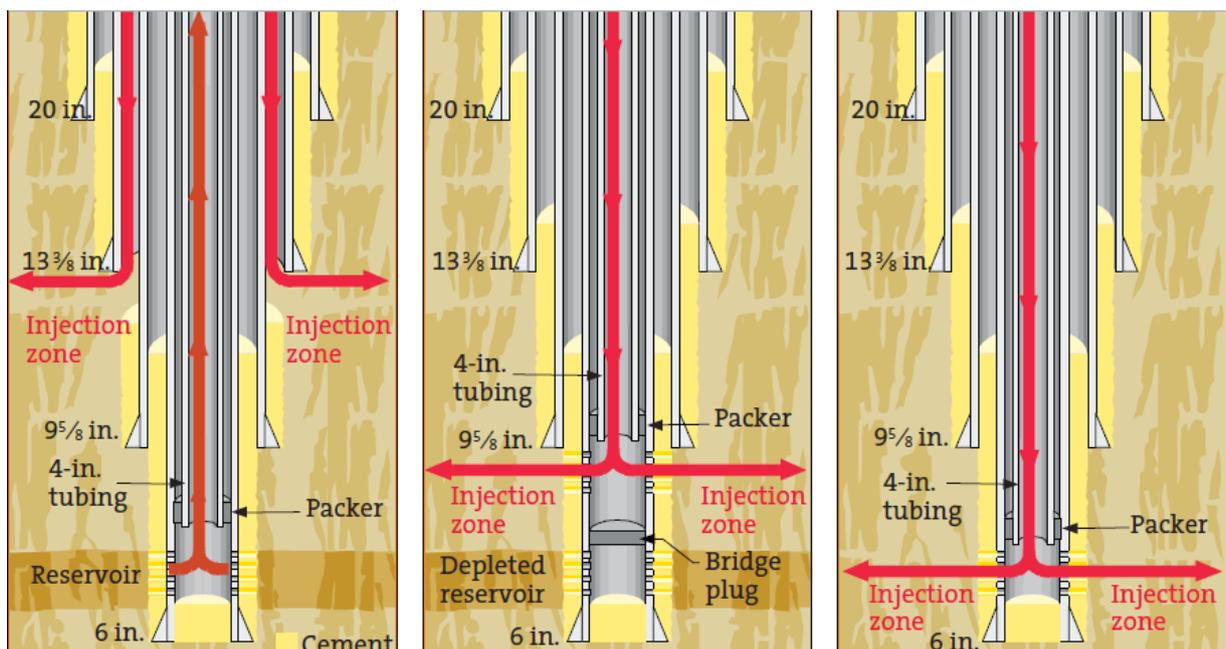


Figure 1 – Options for injecting cuttings (M-I SWACO)

Types of materials which can be injected into the formation depend on local legislation, for example, it may be:

- Slurrified cuttings;
- Crude-oil-contaminated cuttings;
- Lube oil;
- Rig drain fluids;
- Waste mud;
- Some of radioactive materials.

To ensure high quality operations experts analyze the potential injection well and make the plan of injection. Pre-operation analysis includes:

- Geology review;
- Selection of injection zone;
- Hydraulic fracture simulations;
- Well design;
- Operational procedures development;
- Injectivity tests design;
- Risk identification;
- Mitigation options.

From this information companies develop a comprehensive implementation plan for the CRI procedure.

Operation monitoring. Throughout the Cuttings Re-Injection operation, companies use equipment to collect data in real-time to control critical factors:

- Injection rate;
- Injection pressure;
- Slurry properties (density and viscosity);
- Breakdown pressure;
- Closure stresses.

Critical factors for planning a successful CRI operation. In the CRI process we can distinguish 5 basic components for a successful operation:

1. Slurry containment. Containment of injected slurry is a very important factor. Target formations must be selected carefully, ensuring they are covered with sufficient cap rock to ensure that slurry cannot migrate to the surface.

2. Slurry rheology. The slurry must have a uniform consistency and possess the correct carrying and suspension characteristics to prevent solids dropout. Poorly designed slurries can lead to line blockages, packed annuli or fracture bridging.

3. Particle size. Too big particles may cause the plugging of fractures.

4. Surface injection system. A successful CRI operation requires a system capable of delivering the required fluid volumes downhole at adequate pressures.

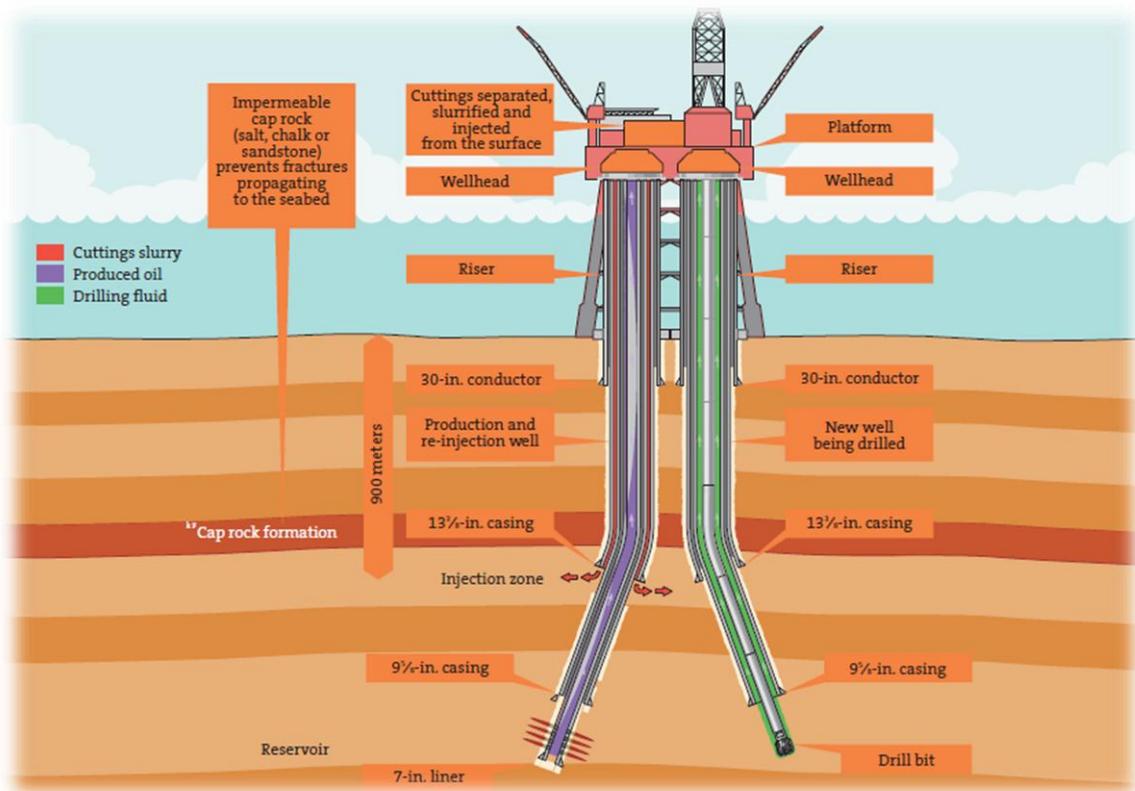


Figure 2 – Annular Re-Injection (M-I SWACO)

Cuttings Re-Injection system includes three principal components:

a) The cuttings-transport system;

It includes a variety of equipment:

- Gravity collection and water or slurry-flushing capability;
- Augers or belt conveyors;
- Vacuum transport systems;
- Pneumatic system.

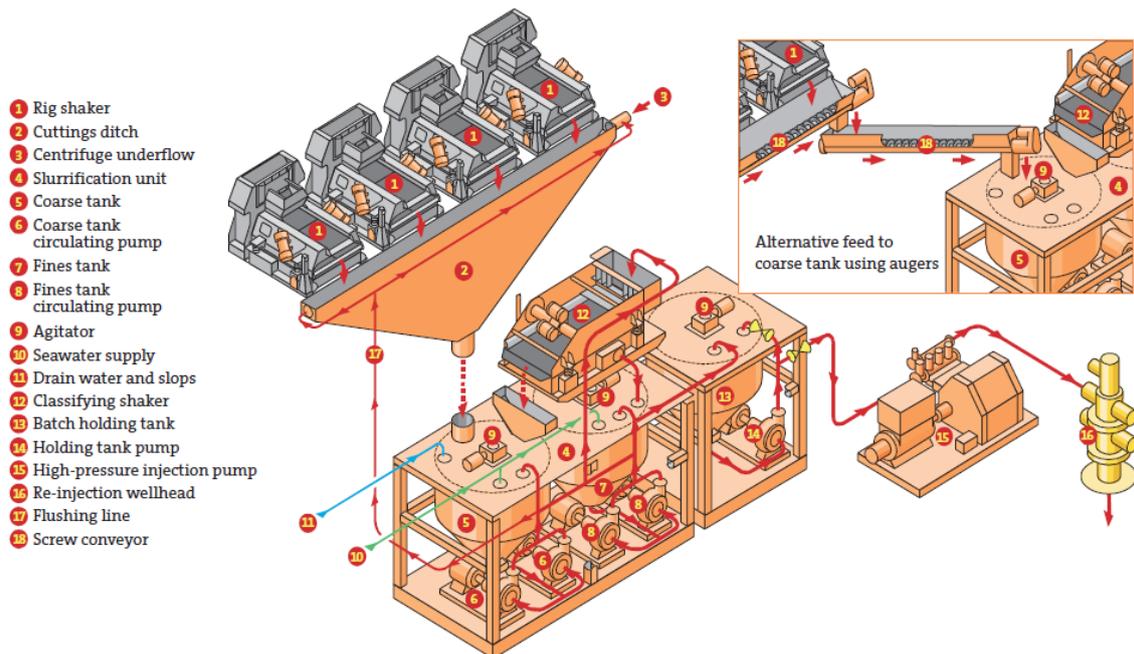


Figure 3 – Slurry flush or auger cuttings transport (M-I SWACO)

b) The slurrification system. It is here that the raw cuttings from the rig shale shakers are converted into a pumpable, stable slurry. This includes:

- Coarse-solids tank;
- Fine-solids tank;
- Classification shaker;
- Process-control system.

c) The re-injection package. Most injection packages include:

- Batch holding tank;
- High-pressure injection pump;
- High-pressure injection line;
- Data acquisition and interpretation package.

There is also the Cuttings Re-injection technology for onshore applications . A mobile CRI is utilized to move from one onshore location to another where CRI operations are preferred.

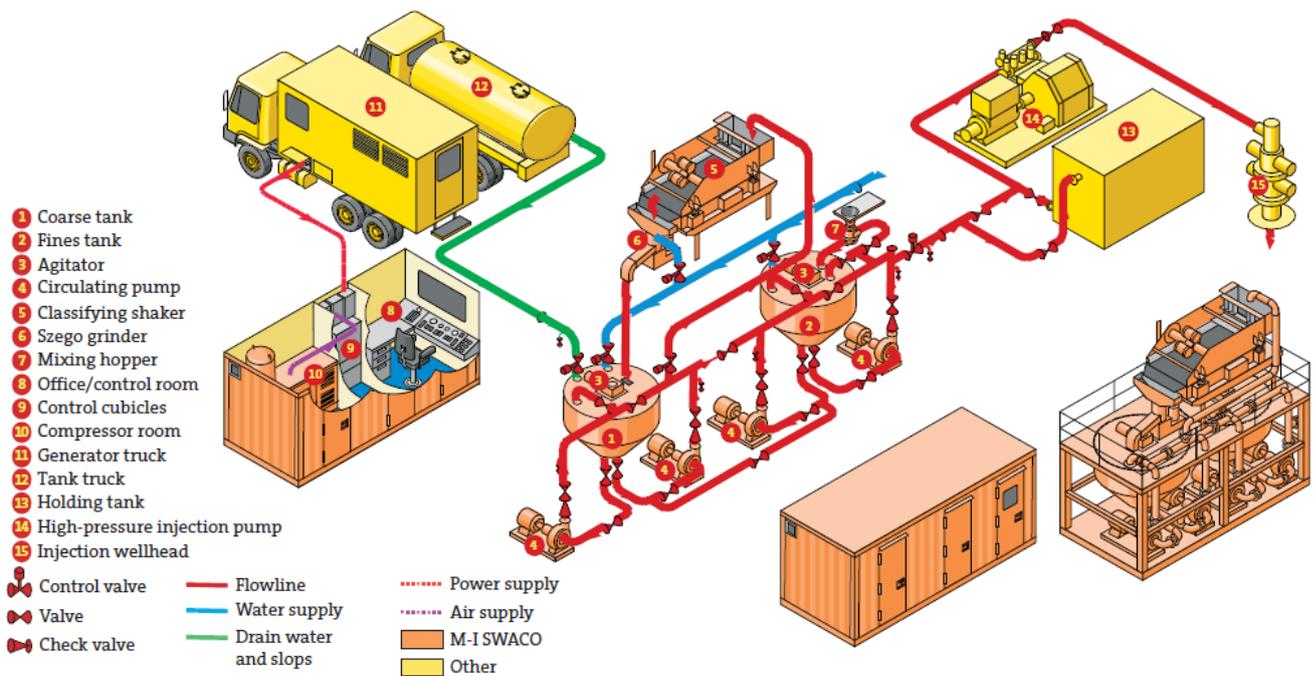


Figure 4 – Mobile waste re-injection system (M-I SWACO)

Cuttings Re-Injection is one of the most perspective technologies of the disposal of drilling waste. CRI projects get more complicated, and it creates a number of problems. These problems can be solved, so the development and improvement of the CRI continues.

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