Waste Injection

The cost-effective, environmentally sound solution for drilling waste disposal
Onsite cuttings disposal
- Achieves zero discharge
- Maintains goal of total cuttings containment
- Assists in environmental compliance
- Can be done through tubing or the annulus
- Lowers CO₂ emissions compared to other waste-management technologies
- Is a cost-effective alternative disposal method
- Reduces cuttings transport and landfill disposal fees
- Enables successful operations through engineered design and monitoring and analysis services
- Collection and disposal are accomplished without costly downtime

Environmentally responsible
- The practical option for onshore and offshore drilling areas with zero-discharge policies

Operationally reliable
- Field-proven technology
- Redundancy features to enhance reliability. Shutdown of one component does not stop cuttings processing
- Equipment built to the highest quality standards for safety and consistent performance
- 24-hr monitoring analysis coverage

Equipment flexibility
- Modular components are custom-configured to adapt to cuttings volume, flexibility, space availability and other specific client requirements
- Vacuum and pneumatic conveyance system provides more options for location of equipment, allowing placement where other conveyance systems could not work
- Compact size leaves more floor space for other drilling operations
- High processing rates

Expertise
- Operations performed by highly qualified and specialized M-I SWACO® personnel assuring maximum efficiency
- Authorized licensee of the patented ARCO slurrification / re-injection process
APPLICATIONS
Onshore and offshore projects, especially in remote and environmentally sensitive locations.

PROBLEMS
Disposal regulations and policies have tightened, especially in remote and environmentally sensitive areas. A well-planned process is required to manage all waste and comply with discharge policies.

SOLUTIONS
M-I SWACO has optimized the Waste Injection (WI) process, matching it to your development program requirements. Our integrated service is complete: from preliminary engineering studies through implementation and including continuous injection pressure monitoring and analysis for process assurance.

ECONOMICS
Traditional disposal practices, especially those which could result in reliance on storage and transport, may present costly safety and logistical challenges and exposure that can lead to long-term liability. When coupled with advanced technologies for managing logistics, WI offers permanent solutions for disposal of wastes from upstream and downstream sectors.

ENVIRONMENTAL
WI is an environmentally compliant solution. Not only does it meet with zero-discharge regulatory requirements, it also has a low carbon footprint relative to other waste-disposal technologies, making it an ideal solution for environmentally sensitive locations.

Compliance with constantly tightening environmental regulations requires a competent, trusted partner.
As environmental regulations and corporate strategies become stricter, and with operating companies being held accountable for proper waste management, there is a need for the safe disposal of many drilling wastes in addition to oil- and synthetic-base fluids. In hundreds of applications throughout the world, WI has proven to be an effective solution for the disposal of waste in both onshore and offshore environments. Performing this service in a safe, cost-effective manner, however, requires experience, specialized skills and global resources — the type that M-I SWACO is uniquely qualified to provide. Our approach takes advantage of a quality alliance formed between M-I SWACO engineers and technicians and client representatives to promote optimized and secure waste disposal.

M-I SWACO WI services have now expanded to include many of the wastes that may be generated during the exploration, drilling and production phases of your asset development. Our policies and procedures — the product of years of experience — are combined with global technology centers and a technical resource network to offer a comprehensive, validated disposal strategy and execution plan.

The cost-effective, environmentally sound solution that complies with worldwide environmental legislation
Overview

Generally, the WI process involves gathering and conveying solids and liquids through a series of components that classify, degrade, mix, and condition them into stable and pumpable slurries. The next step is to inject them via hydraulic fracturing into a subsurface formation that is receptive and permanently isolated at a safe depth to prevent propagation to undesirable zones or even the surface. Before any injection work begins, however, a feasibility study is done to determine the proper injection formation and define the operational guidelines for the project.

Equipment packages consist of a conveyance apparatus, slurrification unit (the main component), high pressure injection pumps, and monitoring equipment. System configurations vary because onshore and offshore injection systems face different constraints, including space availability and the manner in which the operation will have to interface with a drilling operation.

To meet constant demands for system components with smaller footprints, M-I SWACO is continually introducing new and enhanced technologies, such as the Human-Machine Interface (HMI) Technology control system. Real-time monitoring of injection slurry rheology is also becoming a reality with the introduction of the M-I SWACO WASTE INJECTION ANALYST skid unit that delivers injection pressure, density and volume data analysis on a real-time, recordable data basis. The monitoring and diagnostic software package provides the operator with real-time graphic reporting and modeling of the injection operation and highlights any detected risks so that corrective action can be taken. All data can be logged for subsequent analysis and review.
The basic components of WI are:
- Waste collection and conveyance mechanism
- Slurrification and high-pressure pump systems
- Injection well
- Subsurface disposal domain
- Data collection and monitoring

Our front-end analysis, data interpretation and real-time monitoring and intervention programs enable safe and on-time delivery of your oil and gas assets. Waste Injection comprises a significant part of our injection expertise.

Types of wastes suitable for injection

WI was originally designed to inject drilled cuttings, but has subsequently evolved to include the disposal of a range of other waste streams. Generally, the following types of materials may be injected, depending on local regulations:
- Bulk slurred cuttings
- Crude-oil-contaminated cuttings
- Separator sand and produced sand
- Lube oil
- Cleanup pills
- Rig drain fluids
- Waste mud
- Low Specific Activity (LSA) materials
- Produced water
1. Geology and data evaluation
2. Geomechanical model and simulation
3. Well and operation design
4. Data acquisition
5. WI operations and monitoring
6. Model validation

Waste Injection Assurance process

Fracture validation charts
Geomechanical evaluation chart
Fracture propagation predictions
Fracture analysis charts
Real-time slurry measurement
Well profiling
Waste Injection Assurance process

The Waste Injection Assurance process provides a holistic approach to all aspects of a WI project. From analysis of information provided by the client, M-I SWACO can engineer fully optimized solutions that suit the needs of each project. Our process is unique within the industry and offers insight before, during and after the full WI project cycle. It significantly enhances the opportunities for a successful and cost-effective project.

Waste Injection Assurance delivers

Waste injection performed within the M-I SWACO Waste Injection Assurance process provides a range of benefits to our clients:

- Maximum disposal capacity and life of host injection domain
- Long-term disposal of waste in deep formation structures
- Reduced risk of costly non-productive time caused by WI failure
- Reduced risk of late production due to WI failure
- Reduced risk of an environmental incident due to surface breaches
- Reduced liability associated with other waste-disposal options

Geology and data evaluation

M-I SWACO incorporates Waste Assurance methods that enhance Front End Engineering and Design (FEED) studies to an advanced level of detail. This includes the geological evaluation of key elements of the domains proposed for disposal. FEED also produces the information needed for the design of the surface equipment, subsurface capacity, volume of waste, casing design, injector well or annuli, and other details required to comprehensively engineer the injection project.

Geomechanical modeling and simulation

Evaluation of a computer-modeled lithological column based on drilling, logging and well testing data is performed to identify the lithological sequence and a formation’s suitability for the disposal of cuttings slurry.

Geological evaluation will also be used to identify waste containment and fracture-arrest formations.

Secure, stable, long-term containment of injected waste is the main objective of all WI projects. Target formations must have sufficient cap rock to ensure the waste is fully contained and cannot propagate to the surface. This is established through an in-depth geology and fracture modeling study, utilizing some of the industry’s most sophisticated software.

Well and operation design

For successful WI, it is crucial that the system delivers the required fluid volumes downhole at adequate pressures. Design of the process to satisfy disposal volume requirements and geological conditions are also key deliverables of the FEED study. WI projects can be designed to meet the specific challenges and issues of any drilling location.

Data acquisition

The quality of the slurry injected is critical for any successful injection project. M-I SWACO has designed a slurry-monitoring device for online slurry quality control. It monitors real-time slurry rheology, density, pumping rate, and surface and downhole pressures to help keep the injection within design parameters.

WI operations and monitoring

Process parameters such as slurry properties, injection pressure and rates, fracture close-in times and other operational data are used in the injection-cycles analysis. Industry leasing pressure analysis and proprietary fracture simulation software are applied to aid in reaching maximum injection capacity and longevity of the disposal domain.

Model validation

The objective of model alignment is to calibrate the original model for the injection well by comparing predicted pressure response with the actual pressure observed. This provides an asset-management tool for predicting actual storage capacity — and residual capacity as injection takes place — together with a continuous risk assessment based on the actual in-situ formation response. Our risk assessment tools minimize any uncertainty onsite and help match implementation to initial predictions.

Monitoring injection assurance

The monitoring function uses injection pressure data to analyze fracture behavior and provides early warnings of injection problems. The analysis of ongoing operational data, specifically injection pressure responses during both injection and shut-in, will allow the continuous evaluation of injection operation performance. This evaluation is used to calibrate and validate fracture height and length for containment assurance, while allowing for the fine-tuning injection parameters to optimize the injection process along with overall capacity and performance of the injection well.

Our unique WI ANALYST monitoring and diagnostic system offers real-time quality control and assurance of slurry rheology, density, pumping rate and pressure.
Critical factors for planning a successful WI operation

Within the WI process, M-I SWACO considers four components critical to the successful execution of any WI project.

1. Waste containment. Assurance of safe, stable long-term containment of the injected slurry is the most important WI consideration. Target formations must be selected carefully, ensuring they are covered with sufficient cap rock to keep slurry from migrating to the surface. This would be determined from a geology and fracture modeling study carried out during the planning stage of the project.

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 plugging.

3. Particle size. Particles that are too large may cause bridging of subsurface fractures and thereby reduce or impede the formation’s ability to receive injected materials. The particle size is matched to project specifics.

4. Surface injection system. A successful WI operation requires a system capable of delivering the required fluid volumes downhole at adequate pressures. Each M-I SWACO WI system is configured to satisfy the disposal-volume requirement and fit the space availability at the site. Equipment is normally skidded to allow utilization at several points in a close cluster. However, flexible conveyance technologies permit the WI system to be distributed throughout the available space when necessary.

Generally speaking, any WI system is comprised of three principal components:

a. The cuttings-transport system. This encompasses a variety of equipment, including:
   - Gravity collection and water or slurry-flushing capability — always preferred but not always possible
Augers or belt conveyors — may be a good option if the rig lends itself to locating the slurry skid close to the cuttings ditch and on the same or lower elevation

Vacuum transport systems — may be a good option if the WI equipment layout is more widespread or is a deck higher than the cuttings ditch

The CLEANCUT* pneumatic system from M-I SWACO, which is by far the most flexible transport system, provides many more options for locating the WI equipment. It also delivers cuttings-storage capabilities for large hole sizes and well-injectivity problems

b. The slurification system. It is here that the raw cuttings from the rig solids-control equipment are converted into a pumpable, stable slurry. Thorough planning of the system is crucial because the quality of the slurry will determine the success of the WI process. Typically, the elements include:

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

c. The injection package. M-I SWACO can help you determine the ideal injection system for your needs, factoring in the characteristics of the slurry, the injection well and the required hardware. Most injection packages include:

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

Another significant development in WI is the M-I SWACO MOBILE SLURRIFICATION* system for onshore applications. A mobile WI unit is utilized to move from one onshore location to another where WI operations are preferred. In most cases, injection is performed utilizing a redundant well as the disposal well and the WI system injects stockpiled cuttings and other waste streams on a batch basis. Once the stored waste has been injected, the system is rigged down and moved on to the next location.

Site-specific configurations

M-I SWACO can engineer and arrange the components of a WI package to meet the challenges, issues or limitations found at any onshore or offshore drilling site. Whether it is fast, large-diameter drilling; a space-limited work area; sub-zero temperatures; or required mobility, M-I SWACO can help. We have the technologies and experience to carry out WI operations while complying with all QHSE guidelines, with no negative impact on the progress of your well. Designed and implemented in 1999, the M-I SWACO MOBILE SLURRIFICATION system for onshore applications continues to work 24/7 in environmentally sensitive areas in the U.S. Arctic. This unitized, modular unit may move as a single unit, optimizing drilling time or be reduced to truckable modules for transport almost anywhere.

Training and competency

M-I SWACO is committed to assuring the competency of personnel and delivers both theoretical and practical hands-on training solutions in all aspects of the WI process to both employees and customers. Training centers around the world are fully equipped with training rooms, WI CLEANCUT training simulators, a full-scale WI slurification system, a CLEANCUT waste collection and transport system, a VACUUM COLLECTION SYSTEM* (VCS*) and an M-I SWACO 518 CENTRIFUGE*. The WI curriculum is competency-based, requiring trainees to complete trainer-assessed tasks and follows the requirements of ISO 9001 and ISO 10015.
Our record speaks for itself
M-I SWACO has been providing WI services to the petroleum industry since 1991. Along the way, several benchmarks have been set at some of the highest profile, most environmentally sensitive areas of the world, including the North Sea, Alaska, Azerbaijan, Mexico, Canada, and Russia. Millions of barrels of waste slurry have been injected on single long-term project sites.

Let M-I SWACO engineer a WI solution for you
Your M-I SWACO representative can show you how we can reduce your disposal costs and logistics problems with a WI system matched to your needs. Just contact your local M-I SWACO representative.
Ask your M-I SWACO representative to demonstrate how we can reduce your disposal costs and logistics problems with a waste injection system matched to your needs.

1. Alaska
2. Angola
3. Argentina
4. Azerbaijan
5. Brazil
6. China
7. Denmark
8. East Canada
9. Mexico
10. Nigeria
11. North Sea
12. Norway
13. Peru
14. Russia
15. Saudi Arabia
16. Trinidad
17. United States
18. Venezuela