Hydrocarbon Tank Cleaning Best Practice

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Introduction:

environmental protection policy

Policy Statement

Saudi Aramco considers environmental protection an integral pillar of its social license to operate. Emanating from this firm belief, the Company will ensure that its projects/operations are in compliance with the Kingdom’s environmental regulations and do not create undue risks to the environment, public or workers’ health. Saudi Aramco will strive to conserve natural resources and minimize emissions and the environmental footprint of its activities through continuous optimization of Company operations, and leveraging technology advancements and industry best practices. The Company will work toward promoting the conservation of natural biodiversity within its reservations.

Regulations

- In all its projects/operations, the Company will attain the highest level of compliance with the Kingdom’s environmental regulations. Where there are no established national regulations, the Company will develop environmental standards aligned with industry best practices and compatible with the Kingdom’s environmental protection objectives.
- It is the responsibility of each Company organization to ensure that its facilities are designed, constructed and operated in compliance with the corporate Environmental Protection Policy.
- The Company will maintain corporate environmental programs to monitor the compliance of Company organizations with environmental regulations/standards.
- Each Company organization shall strive to continuously enhance its environmental performance to conserve natural resources, reduce the environmental footprint of its activities and conserve biodiversity within areas of its operations.

President & Chief Executive Officer

沙特阿美: 公司概况

环保政策

政策声明

沙特阿美认为环境保护是一个重要的社会契约支柱。基于这一坚定信念，公司确保其项目/运营符合王国的环境法规，不造成对环境、公共或工作者健康的不可接受风险。沙特阿美将努力节约自然资源和减少排放，并通过持续优化公司运营，以及利用技术进步和行业最佳实践，来保护和促进自然资源和生物多样性的保存。

法规

- 在所有项目/运营中，公司将达到最高的合规水平，符合王国的环保法规。在没有国家法规的地方，公司将制定环保标准，并使其与行业最佳实践和王国的环保保护目标相兼容。
- 每个公司组织有责任确保其设施按照公司的环保政策设计、施工和运营。
- 公司将维护公司的环境计划来监测公司组织对环境法规/标准的合规。
- 每个公司组织应致力于持续提高其环保绩效，以保存自然资源，减少其活动的环保足迹并保护其内的生物多样性。

董事长兼首席执行官
Waste Management Hierarchy:

1. **AVOID**
2. **REDUCE**
3. **REUSE**
4. **RECYCLE**
5. **RECOVER**
6. **DISPOSAL**

Most Favored Option

Least Favored Option
Hydrocarbon waste from tank bottoms:

- Major source of hazardous waste in Saudi Aramco
- Current method:
  - Manual scarping during T&I events
  - Health issue
  - Lengthy cleaning process
  - Generates hazardous waste
  - No recovery of hydrocarbons
  - Costly
  - Potential land contamination
  - Lose-lose cleaning method
Regulations and procedures:

- Oily sludge is hazardous waste
- More than 20,000 m³ is generated every year from tank bottoms
- Managed through third party hazardous waste management facilities
- Generated during T&I events every 10 years
- Waste management method is through land-farming
Ways to minimize oily sludge generation

• Keep turbulent flow in tank to prevent sedimentation by the use of mechanical stirring devices
• Add appropriate chemical agents to reduce tank bottom accumulation
• Recover product by recycling light oil tank bottoms through heavy oil dehydration facilities
• Reduce the number of tanks by consolidating produced fluid storage facilities
• Keep a gas blanket on tanks to reduce oxygen and formation of iron oxides
• Identify and minimize the source of solids
Saudi Aramco crude oil tanks

- **Locations**
  - Refineries
  - Terminals
  - Pump stations
  - Oil stabilization plant

- **Types of crude oil:**
  - Arab Light
  - Arab Medium
  - Arab Heavy
  - Arab Super Light
  - Arab Super Extra Light
Approach and methodology:

1. Evaluate existing tank sludge characterizing data
2. Collect oily sludge samples during T&I
3. Review results for tank cleaning technology demos and determine availability in the local market
4. Review current best company practices at Saudi Aramco facilities, including local joint ventures
5. Compile results and develop best practice
Review current best company practices

• Surveyed all crude oil tank operators
  - Refineries
  - Terminals
  - Pump-stations
  - Oil stabilization plants
  - Local joint ventures
• Reviewed previous questionnaire
• Reviewed internal procedures
• Reviewed previous T&I reports
Oily sludge sampling data

- Collected oily sludge samples during T&I events
- Objective is to create a waste profile for each type of crude oil
- Analyzed for the following parameters:
  - TCLP
  - TPH
  - VOC
  - SVOCs
  - Physical properties
Review results for tank cleaning technology demos

• Attended demos in Oman-2010
• Attended demos in Saudi Aramco-2015
• Attended meeting with different tank cleaning service providers
Criteria identified:

- Minimum disturbance to operation
- No or minimum exposure of personnel inside the tank (i.e., technology is fully automated)
- Maximum oil recovery from oily sludge
- No or minimum waste generation from tank bottoms
- Minimum resources needed for cleaning
- No or low design modifications to the crude oil storage tanks intended for cleaning
- A mobile unit
- Comply with minimum hydrocarbon emissions and polluting effluents
- Comply with Saudi Aramco applicable standards with regard to health safety requirements
Tank Cleaning methods identified:

• Those that circulate a cleaning fluid (oil or hot water) through nozzles installed inside the tank to dissolve and mobilize the sludge

• Those that use robotic devices to extract the sludge
Crude Oil Washing System:
Mechanical removal through hot water using robotics:
Automated tank cleaning method (closed tank):

Dry Crude Storage Tank (floating roof tank)

Filtration Module

Oil Water Separation Unit

Recirculation Two Pumps Heat Exchanger

Crude Oil

Water

Oily water

Source of Wash Water

Oily water back to plant process
Benefits perceived from adopting new best practice:

1. **Health & Safety:**
   - No direct exposure to personnel

2. **Environmental:**
   - Closed system, no oil spills, and no sludge accumulation
   - Reduce hazardous waste management
   - Water Conservation (closed recycled wash water system)

3. **Efficient and Effective:**
   - 10-12 Weeks (Automated) vs. 20-24 weeks (Manual)
   - Proved to be effective cleaning method

4. **Economics:**
   - Recover valuable hydrocarbons from oily sludge
   - Significant reduction in waste management costs
Best Practice Document:

• Selection criteria,

• Technologies available in the region,

• Adopted oily sludge minimization methods,
Conclusion:

• Automatic tank cleaning proved to be a success
• Best practice is a guide for crude oil tank operators to utilize
• Saudi Aramco facilities continue to see the benefits and widespread implementation is observed
• Automatic cleaning method worked with all types of crude oils
Thank you …