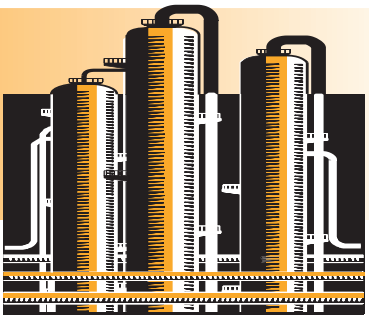
PETROLEUM

Project Fact Sheet



Fouling Minimization

Benefits

- Improvement of energy efficiency recovering up to 0.2 quads per year
- Potential cost-reduction up to $2 billion per year
- Increased capacity without significant capital expenditure
- Reduced propensity of localized corrosion
- Reduced risk of tube failures in furnaces

Application

This project is establishing operating procedures to allow refineries to operate equipment below threshold fouling conditions and use the most effective minimization techniques. These include physical and chemical methods and high-temperature coatings. The new and improved minimization techniques will be applied without major equipment modifications, thereby achieving near-term benefits of improved energy efficiency and productivity.

Effective fouling minimization increases the efficiency and productivity of refineries

Fouling is a leading cause of diminished efficiency and productivity in refineries. Fouling is a deposit buildup in refinery process units which impedes heat transfer. The energy lost due to this inefficiency must be supplied by burning additional fuel. The cost penalty of fouling is believed to be in excess of $2 billion per year in U.S. refineries alone. Also, the localized coking in refinery furnaces is responsible for tube failures leading to major safety hazards. A project, conducted by Argonne National Laboratory (ANL) in cooperation with Amoco, Chevron, and Equilon has the goal of minimizing fouling, thereby improving productivity and environmental performance. This project includes laboratory and field experiments and the development of prediction methods for threshold-fouling conditions. The experiments are designed to determine threshold fouling conditions and the development of new techniques to alter them.

A typical refinery consumes between 350,000 and 550,000 British thermal units (Btu) of energy for processing one barrel of crude oil. In recent years, refineries have made significant progress in heat integration; however, fouling of heat transfer equipment upsets the delicate balance of heat integration. Fouling buildup impedes heat recovery from product streams, and the lost thermal energy must be supplied by burning additional fuel.

Field Fouling Unit

Field fouling unit for refinery experiments.

Project Description

Goal: Improve the energy efficiency by 30 percent and corresponding productivity by minimizing fouling in crude oil preheat trains, furnaces, and feed/effluent heat exchangers in hydrotreating processes.

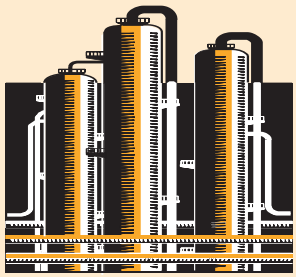
Two field-fouling units have been constructed and are providing valuable field data. These units are installed at the Equilon Wood River Refining Company for crude oil preheat train fouling, and at the Chevron El Segundo Refinery for fouling of feed/effluent heat exchangers in hydrotreating. The development of a knowledge-based system will provide the foundation for the fouling minimization.

This project includes the following objectives:

1. Develop analysis-based strategy to operate equipment below threshold fouling conditions.
2. Develop high-temperature ceramic and other non-ferrous coatings to reduce fouling and to increase the effectiveness of chemical additives.
3. Design sensors that can detect early signs of fouling initiation.
4. Create a knowledge-based system for disseminating the information to the industry.

Progress and Milestones

- Developed prediction methods for crude oil threshold fouling conditions.
- Identified formation of iron sulfide as a key step in initiation of fouling.
- Designed and installed two field-fouling units for refinery experiments.
- Developed compact, low-cost autoclave-based fouling unit for laboratory and field experiments.
- Conducted a workshop in April 1998 on refinery fouling minimization; representatives from major petroleum companies and service providers reviewed the fouling project, and recommended further work focusing on minimization of crude oil fouling.
- The interim milestone is to develop best practice design and operation guidelines for mitigating crude oil fouling.
- The long-term milestone is to develop condition-based maintenance strategy for mitigating fouling in refining processes.



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