Hydrotreatment Processes

Overview

LEVEL
Proficiency

PURPOSE
This course provides a deeper understanding for operating, monitoring and optimizing hydrotreatment units.

LEARNING OBJECTIVES
Upon completion of the course, the participants will be able to:
- grasp the essence of hydrotreatment processes,
- analyze the operation and optimization of hydrotreatment units,
- manage the hydrogen balance in relation with the hydrogen network,
- detect potential deficiencies by troubleshooting.

WAYS AND MEANS
Applications, teamwork, case studies and interactive workshops based on typical real situations.
Potential use of a dynamic simulator.

LEARNING ASSESSMENT
Quiz.

PREREQUISITES
No prerequisites for this course.

Agenda

OBJECTIVES OF HYDROTREATMENT PROCESSES
Impurities in petroleum cuts and products; their impact on health, environment and on other refining processes. Highly refractory compounds.
Recent regulations and future trends: quality specifications of petroleum products and fuels in relationship with concerns mentioned above.
Aim of the various treatments with hydrogen and integration in the refining scheme: hydropurifications of straight run cuts, stabilization or saturation of cracked cuts.

CHEMICAL REACTIONS & HYDROTREATMENT CATALYSTS
Characteristics of the chemical reactions involved: thermodynamic and kinetic aspects, consequences on the operation of units, side reactions and optimum operating conditions to deplete their evolution, specific features of reversion reactions.
Presulfiding procedures: role, steps and details for the different methods.

OPERATION OF A DISTILLATE HYDROTREATMENT UNIT
Operating conditions and compositions of the main streams; mass balance and yields, sulfur balance, hydrogen balance and consumption.
Significance of the operating variables and their influence on the process: mean temperatures and profile, pressures, PPH₂, recycle rate, quench ratio, feed flow rate and space velocity.
Advanced process control and optimization of the process.
Management of the hydrogen network in the refinery. Effect of feed composition and origin.
Catalyst follow up and cycle length optimization, ageing and deactivation.
Regeneration steps and monitoring.
Maximizing the performances of the unit under constraints or limit conditions.

DISTURBANCES, INCIDENTS & TROUBLESHOOTING
Causes of quality decrease and corresponding actions.
Main automatic safety systems.
Feed pump failure, heater failure.
Compressor failure: fresh gas or recycle, adapted reaction and safe shutdown.

PERFORMANCE OF THE VARIOUS HYDROTREATMENT UNITS
For each of the following processes, the operating parameters and the specific operating features are addressed.
Naphtha desulfurization for catalytic reformer and isomerization feed.
Cracked gasoline treatments, special hydrotreatments for the FCC gasoline.
Stabilization of the pyrolysis gasoline.
Hydroisomerization of the C₄ cut out of the FCC to feed alkylation unit.
Hydrotreatment of middle distillates: kerosene and gas-oil, LCO processing.
Desulfurization of vacuum gasoil to FCC units.
Residues demetallization processes.
Hydrotreatments in lube oil manufacturing.