Romania - Ministry of Environment, Water and Forests
National Environmental Guard
Cluj County Commissariat

Elements of Seveso inspections, including specific checklists

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Content

- Case studies on two tragic Seveso accidents in Romania, happened in the same refinery
- Brief description of a refinery processes
- Presentation of checklists to be used during Seveso inspections at refineries
- Presentation of a checklist for IED directive refinery inspection

MOTTO

- *"It should not be necessary for each generation to rediscover principles of process safety which the generation before discovered. We must learn from the experience of others rather than learn the hard way. We must pass on to the next generation a record of what we have learned."*

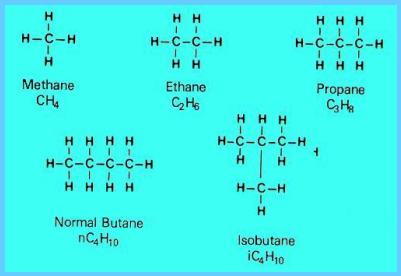
  Jesse C. Ducommun

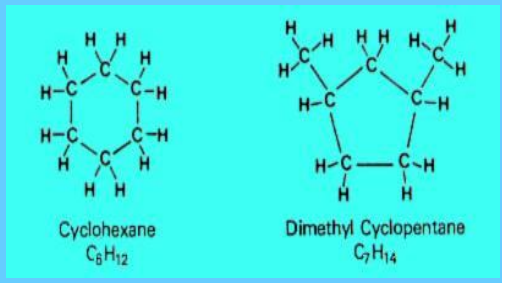
Refineries are high-technology process plants, and the cost of building a large modern refinery is several billion US dollars. The main processes carried out in simple refineries typically include the following:

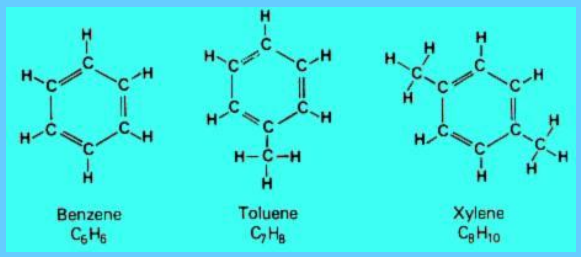
Refinery process	Function	Products
Crude oil storage	*Self-explanatory*	-
Desalter	Removes impurities from crude oil	Clean crude oil
Crude oil distillation column	Separates crude oil into light and heavy components	Naphtha*, jet fuel, diesel, residue
Hydro-treating	Remove sulphur	Desulphurised products
Catalytic reforming, platforming or isomerisation	Converts naphtha to gasoline	Gasoline/petrol
Residual Fluid Catalytic Cracking (RFCC)	Takes residue from distillation column and produces useable product	Gas, LPG, gasoline, diesel, slurry
Thermal conversion and delayed coking plant	Takes heavy oil residue and converts it to coke (batch production only)	Coke
Product storage and blending	*Self-explanatory*	Blended products to meet market needs

*Naphtha is defined as the fraction of hydrocarbons in petroleum boiling between 30 °C and 200 °C

What is petroleum? Petroleum consists of three main hydrocarbon groups: Parafine, Naphthenes and Aromatics







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The refining process

- Every refinery begins with the separation of crude oil into different fractions by distillation. The higher is its molecular weight the higher is its the boiling point.
- The fractions are further treated to convert them into mixtures of more useful saleable products by various methods such as cracking, reforming, alkylation, polymerization and isomerization.
- These mixtures of new compounds are then separated using methods such as fractionation and solvent extraction. Impurities are removed by various methods, e.g.. dehydration, desalting, sulphur removal and hydrotreating.

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Distillation (Fractionation)

- Because crude oil is a mixture of hydrocarbons with different boiling temperatures, it can be separated by distillation into groups of hydrocarbons that boil between two specified boiling points. Two types of distillation are performed: atmospheric and vacuum.

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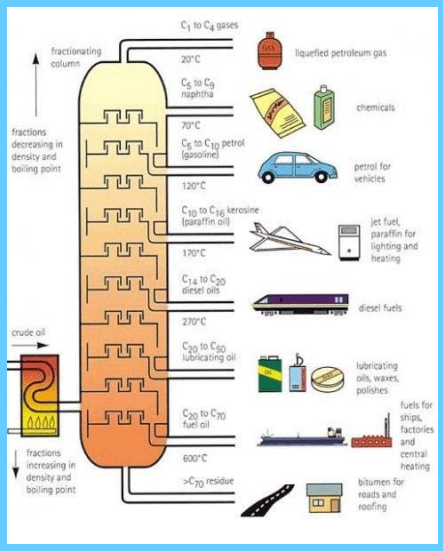

Reforming

- Reforming uses heat, pressure and a catalyst (usually containing platinum) The naphthas are hydrocarbon mixtures containing many paraffins and naphthenes. Reforming converts a portion of these compounds to isoparaffins and aromatics, which are used to blend higher octane petrol.
  - paraffins are converted to isoparaffins
  - paraffins are converted to naphthenes
  - naphthenes are converted to aromatics

catalyst

heptane -> toluene + hydrogen

$C_7H_{16} \rightarrow C_7H_8 + 4H_2$

catalyst

cyclohexane -> benzene + hydrogen

$C_6H_{12} \rightarrow C_6H_6 + 3H_2$

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Cracking

- Processes that break down heavier hydrocarbon molecules (high boiling point oils) into lighter products such as petrol and diesel. Processes include:
- catalytic cracking
- thermal cracking
- hydrocracking.

A typical reaction:

catalyst

$C_{16}H_{34} \rightarrow C_8H_{18} + C_8H_{16}$

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Alkylation

- Olefins such as propylene and butylene are produced by catalytic and thermal cracking. Alkylation refers to the chemical bonding of these light molecules with isobutane to form larger branched-chain molecules (isoparaffins) that make high octane petrol.

catalyst

isobutane + butylene -> isooctane

$C_4H_{10} + C_4H_8 \rightarrow C_8H_{18}$

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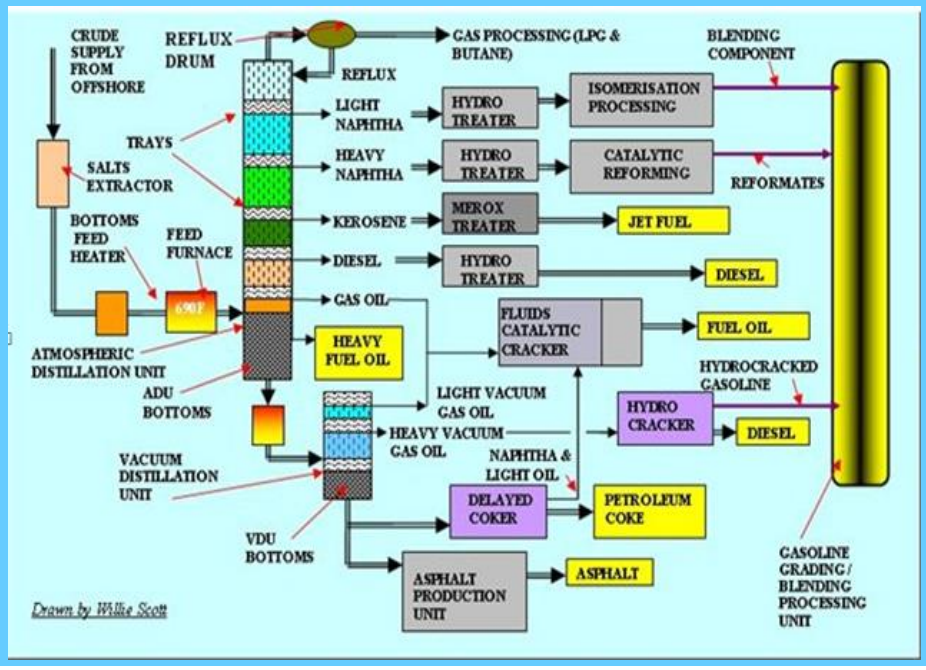

Refineries are undoubtedly very hazardous, high risk facilities. The hazards and risks mainly arise because they process hydrocarbons at high temperature and high pressure

- A leak of high-pressure gaseous hydrocarbon can, if it ignites immediately, produce a jet fire which can impinge on other process plant and then escalate to become a large conflagration
- An un-ignited leak of high-pressure gaseous hydrocarbon can quickly generate a large, inflammable cloud which may drift until it finds an ignition source, and it can then yield a vapour cloud explosion.
- A spill of liquid hydrocarbon may catch fire and yield a pool fire.

- Accidents in refineries are among the most devastating ones
- In many cases there are a lot of fatalities and severe injured persons
- At least 53 major accidents took place between 1972 and 2011.
- Any given refinery has about a one in a ten chance of suffering a major accident during its operational lifetime

Case study : The explosion of Petrochemical installation Teleajen/Romania

- The installation was supposed to enter into production On December 7 -1983 (St. Nicholas)
- Location : Eastern part of Ploiesti city
- A huge explosion took he place on the night 6/7 December
- At first research was hypothesized to be a sabotage addressed to the Romanian communist dictator.
- One technical subcommitee and one safety work subcommitee were charged for investigation.

- Technical Subcommittee defined the failure as a "technical accident“ and damage estimated as being 35 million US dollars
- Safety Subcommittee reported that there have been numerous casualties, 40 dead, many maimed for life, seriously or slightly injured. The explosion was so powerful that some of the bodies of the victims were never found
- Unfortunately, under political pressure, the safety subcommittee sets unreasonable and unlawful charges against some engineers who worked at facility during technological tests

Political instrumentation of the disaster

- A manifestly political process conducted by the Ministry of Justice given sentences between five and eight years' imprisonment, confiscation of property and imputations between 500-700000000 lei(~ 35 million USD)
- After their release those indicted were employed in production minimum wage and without recognition of seniority.

  After the events of December 1989, those sentenced engineers unfairly were and they were paid damages. But money does not cover psychological trauma and health shaken as a result of unjust detentions.

Real cause

- The real cause of the accident was negligence or incompetence of those who assembled the plant.

  A column of technological flux where was supposed to pass a hydrocarbon fluid at very high temperatures and than at very low temperatures, was installed a steel pipe strength only at very low temperatures. So that the fluid flow with high temperatures, producing pipe rupture, followed by a destroyer explosion.

  The most obvious proof of this interpretation was finding fragment of steel which was stamped with steel category

New explosion in 1985, at the same installation

- A new tragic explosion took place in 1985, again with many fatalities, including members of firemen teams.
- Cause: a propane leakage coming from cracked pipe (due to frozen temperatures) from deasphalting installation)
- This time, the death number was 23 and other 28 injured. The investigation in this case led to the conclusion that it was a technical error.

General questionnaire SEVESO refineries

- LINK to **Questionnaire 1**

Questionnaire for SEVESO refineries installations - for accidents purpose-

- LINK to **Questionnaire 2**

Questionnaire for SEVESO refineries installations audit

- LINK to **Questionnaire 3**

Questionnaire for SEVESO refineries installations audit

- LINK to **Questionnaire 4 IPPC**

References

- Directive 2012/18/EU of the European Parliament and of the Council of 4 July 2012 on the control of major-accident hazards involving dangerous substances, amending and subsequently repealing Council Directive 96/82/EC
- Twinning Project guides: RO/2002/IB/EN-02 /Implementation of the VOC's, LCP and Seveso II Directives
- Mihai Olteneanu: "Management of critical infrastructures"
- copyright Jim Thompson "Refineries and Associated Plant "Three accident case studies "
- Phare project 2005/ 017 – 553.03.03/03.01, National Technical Guidelines on Best Available Techniques for Oil and Gas Refineries : Further support for IPPC and LCP Directives Implementation
- Australian Institute of Petroleum – web page http://www.aip.com.au/industry/fact_refine.htm

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"*The big accidents are just waiting for the little ones to get out of the way."* Carolyn Merritt

"Safety doesn't happen by accident." Anonymous (Safety slogan)

Optimism and stupidity are nearly synonymous." Hyman G. Rickover

Thank you for your attention

Questions?

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