Diagnosis of optimal solutions in refinery planning

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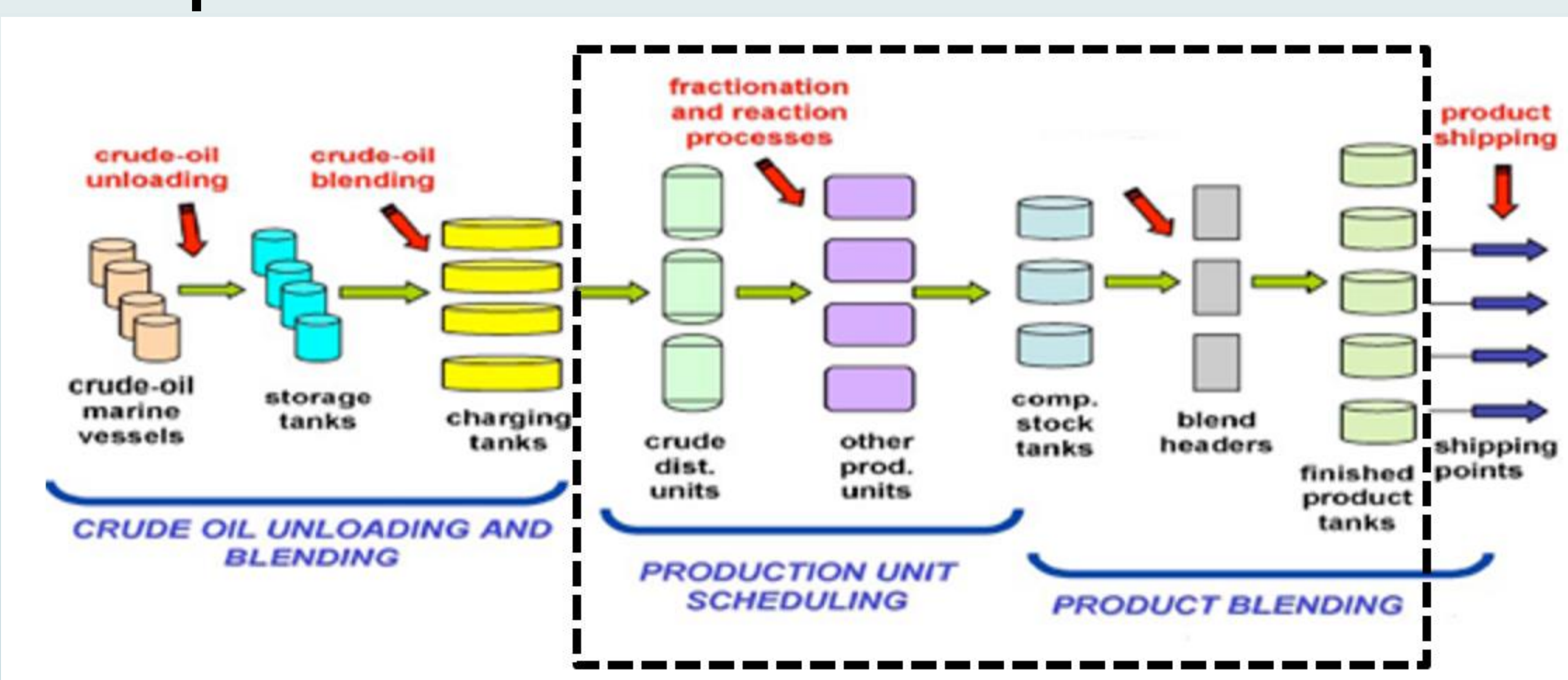
The refinery planning problem

Scope :

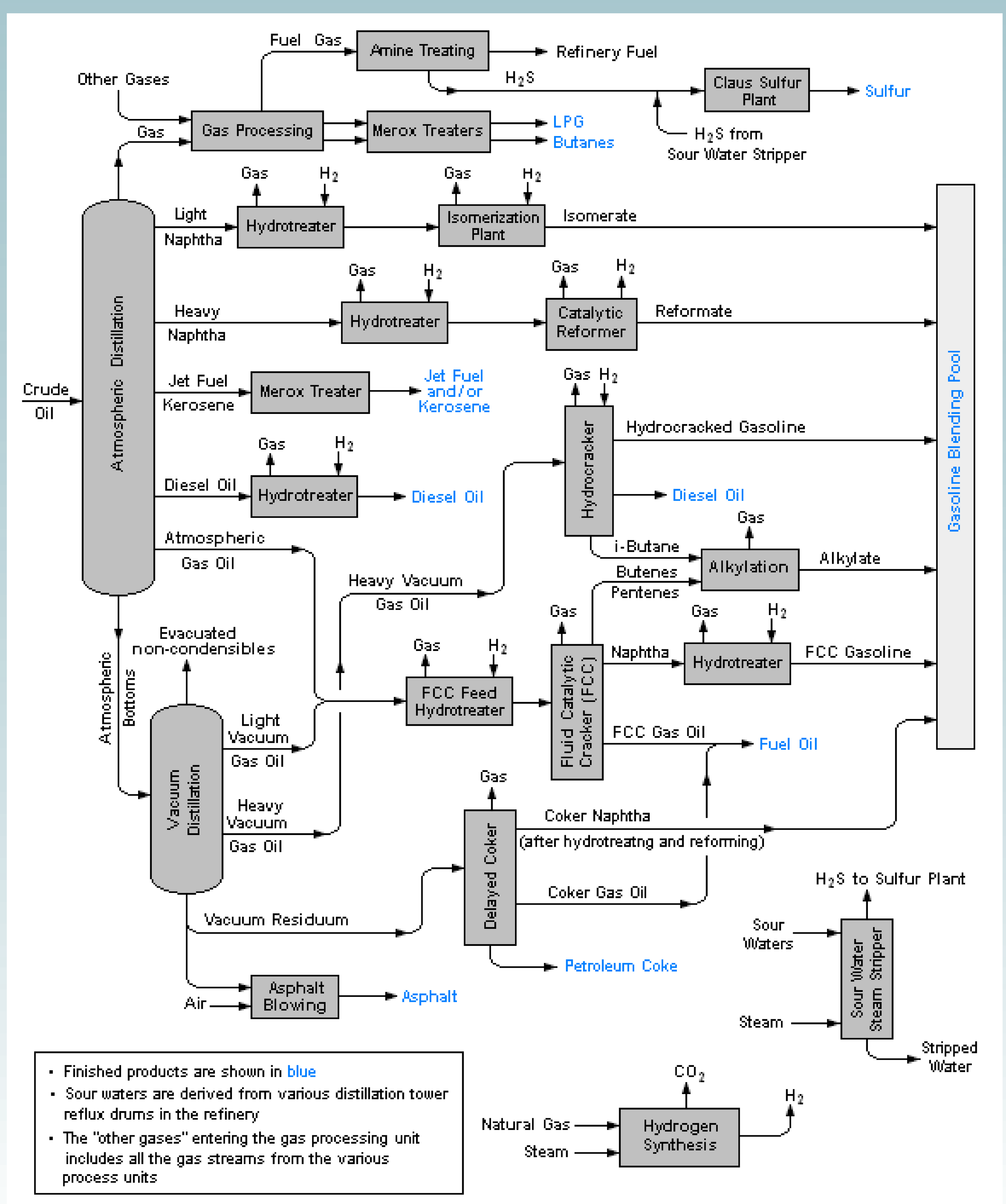


Input :

- Graph of the refinery (cf below)
- Set of crude oil
- Initial stock
- Parameters, prices and contracts

Ouput :

- Process units tuning
- State (quantity and qualities) of all the stream



Problem formulation

x_b^F	Quantity of crude oil b sent to the CDU
$x_{b,m}^F$	Quantity of crude oil b distilled in mode m
y_v	Quantity in the node v
$x_{u,v}$	Quantity of the stream between nodes u and v
q_v^t	Value of quality t at node v
$q_{u,v}^t$	Value of quantity t between the nodes u and v

$$
P_{PGM}\left\{
\begin{array}{lll}
min & \sum_{b\in\mathcal{B}} c_b x_b^F + \sum_{u\in\mathcal{U}} h_u(y_u) - \sum_{p\in\mathcal{P}} c_p y_p & \\
s.t. & & \\
(1) & x_b^F = \sum_{m\in\mathcal{M}} x_{b,m}^F & \forall b\in\mathcal{B} \\
(2) & \sum_{b\in\mathcal{B}} x_b^F \le \overline{CDU} & \\
(3) & \sum_{b\in\mathcal{B}}\sum_{m\in\mathcal{M}} a_{j,m} x_{b,m}^F \le \overline{PC_j} \sum_{b\in\mathcal{B}} x_b^F & \forall j\in[1..|\mathcal{K}|+1] \\
(4) & \sum_{b\in\mathcal{B}}\sum_{m\in\mathcal{M}} a_{j,m} x_{b,m}^F \ge \underline{PC_j} \sum_{b\in\mathcal{B}} x_b^F & \forall j\in[1..|\mathcal{K}|+1] \\
(5) & y_k = \sum_{b\in\mathcal{B}}\sum_{m\in\mathcal{M}} \alpha_{b,m}^k x_{b,m}^F & \forall k\in\mathcal{K} \\
(6) & q_k^t y_k = \sum_{b\in\mathcal{B}}\sum_{m\in\mathcal{M}} q_{k,b,m}^t x_{b,m}^F & \forall k\in\mathcal{K}, \forall t\in\mathcal{Q} \\
(7) & y_k = \sum_{v\in succ_k} x_{k,v} & \forall k\in\mathcal{K} \\
(8) & q_{k,v}^t = q_k^t & \forall t\in\mathcal{Q}, \forall v\in succ_k \\
(9) & y_u = \sum_{v\in pred_u} x_{v,u} & \forall u\in\mathcal{U} \\
(10) & q_u^t y_u = \sum_{v\in pred_u} q_{v,u}^t x_{v,u} & \forall u\in\mathcal{U}, \forall t\in\mathcal{Q} \\
(11) & x_{u,v} = f_0^{u,v}(q_u, In_u) y_u & \forall u\in\mathcal{U}, \forall v\in succ_u \\
(12) & q_{u,v}^t = f_t^{u,v}(q_u, In_u) & \forall u\in\mathcal{U}, \forall t\in\mathcal{Q}, \forall v\in succ_u \\
(13) & Out_u = f_{Out}^{u,v}(q_u, In_u) & \forall u\in\mathcal{U}, \forall v\in succ_u \\
(14) & y_c = \sum_{v\in pred_c} x_{v,c} & \forall c\in\mathcal{C} \\
(15) & q_c^t y_c = \sum_{v\in pred_c} q_{v,c}^t x_{v,c} & \forall t\in\mathcal{Q}, \forall c\in\mathcal{C} \\
(16) & y_p = \sum_{c\in\mathcal{C}_p} x_{c,p} & \forall p\in\mathcal{P} \\
(17) & q_p^t y_p = \sum_{c\in\mathcal{C}_p} q_{c,p}^t x_{c,p} & \forall p\in\mathcal{P}, \forall t\in\mathcal{Q} \\
(18) & q_p^t \le S_p^t & \forall p\in\mathcal{P}, \forall t\in\mathcal{Q} \\
(19) & y_p \ge D_p & \forall p\in\mathcal{P} \\
(20) & \underline{OP_u^i} \le OP_u^i \le \overline{OP_u^i} & \forall u\in\mathcal{U}, \forall i\in Out_u
\end{array}
\right.
$$

First results

Tool under development to visualize the impact of desaturating a constraint.
Saturated constraint in a solution : dual value of 7$/t.

$$7 = \underbrace{\text{Impact on purchases + impact on sales}}_{\text{How much and why ?}}$$

Bibliography

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