INTEGRATION OF REAL-TIME CONTINUOUS-DISTRIBUTION MODELING OF HYDROCARBONS STREAMS INTO REFINERY OPERATION.

Armand P.Brzosko,MSc.Eng.; HMJ Ltd, Engineering Dept, Warsaw, PL;2018.

The world of operators of refineries consists of thousands of real-time measurements of process parameters to run the plant; parallelly to this world, a separate world of process-modellers and simulators exists , which very well represent real plants. As more and more manufacturers of process equipment deliver them with their digital twin – a real-time digital copy, it is time to consider full integration of digital model of the whole process into plant operation system. This paper denotes such a possibility .

Large number of models exists for simulation refinery process : from individual thermodynamic simulators for design or operation of single distillation column as e.g. in ChemCAD , up to models attempting to simulate whole product-life , from delivery of crude through refining , distribution , up to end-user ,e.g. Bagajewicz et al [3].

Major difficulty in exact modeling of the refinery process is complex character of hydrocarbon mixtures. In particular, simulation of distillation process , being a core of refinery technology, is complicated by substantial differences of vapour pressures between pure hydrocarbons and their mixtures. Therefore, most common approach in simulating HC-streams is modeling them as mixtures of pseudo-components. This approach , although produces relatively quick results convergent with real-world apparatuses is however heavily marked with semi-empirical or manual adjustment of coefficients & calculations. More detailed is modeling of the refinery streams by applying probability distribution /density functions for HC-components. Such approach , although initially used mostly for reservoir fluids , (Riazi et al [4]) , seems to be very well transferable also to downstream hydrocarbons mixtures. The physical and chemical transformations in each column or reactor are represented by mathematical operations on continuous distribution functions .
However, although refinery models , both those based on pseudo-component approach as well as those applying continuous PDF like Gamma Distribution Model can deliver results quite well reproducing real –world situations, the operators of the plants , in their daily procedures rely almost exclusively on real-time (or - sometimes -predictive) measurements from field instruments.

Models and simulators exists in their own world, used for design , planning , process verifying or financial estimations.

However, integration of the plant control system with real time modeling, based on PDF - assessment of each stream's –composition could lead to better prediction of process behaviour , in particular under dynamic conditions, by substantially smaller number of field measurements, providing noticeable savings by instrumentation and better reliability.

Mr Armand Brzosko is MSc.Eng, Process Engineer with over 20 years experience in chemical, petrochemical and power engineering and process modeling.

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