280868 An Intelligent Agent for On-Line Optimization of Gasoline Blending

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An intelligent agent for on-line optimization of gasoline blending

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Abstract

Gasoline blending is a batch process where different intermediate products of the refining process are mixed in order to produce a final product to meet some quality specifications. The most important standard specifications for gasoline include: RVP (Reid Vapor Pressure), AKI (Anti knock index), RON (Research octane number), and D-86 distillation as leading properties. It is important to notice that each feedstock differs from the others on its

properties and cost. Therefore, in order to reach a finished product that respects the aforementioned constraints and using the available volume of each feedstock, an optimization problem must be resolved, normally off-line, that is, previously and without intervention in the actual blending process in real time.
In this off-line optimization process two important assumptions are normally made: firstly, that the feedstock quality parameters are constant within a certain period of time for the blending and, secondly, that the models that describe the blending processes are linear or, at most, require only some non-linear adjustments. These assumptions, together with the possible heterogeneity of each feedstock inside the tank, caused by compounds separation because of density differences, often cause the production of a blend to end at some distance from the expected quality , generating high additional costs because of re-blend or quality giveaway: products with better quality than required.
In this work, it was designed and developed an optimizer that implements a novel strategy for executing real time optimization in gasoline blending processes. In order to account for the problems of process-model differences, the optimizer in this work uses blending models automatically obtained from machine learning experiments, specifically learning tasks with Support Vector Machines (SVM). For this purpose we took advantage of the large amount of operational blending data available in a Venezuelan refinery to produce different grades of gasoline.
The basic elements of any strategy for optimization of the gasoline blending process are: 1) the distributed control system (DCS), which executes the control actions on the plant, 2) the optimizer, which makes the calculations using current information from the plant, 3) the on-line analyzer, which determines on-line the feedstock and product properties, and 4) the tank information system (TIS). All of them must and have been considered in order to implement the solving application. All these operational constraints suffice to consider the on-line optimization system as a complex software application that must cleverly interact with other elements of the system during the optimization process. Considering that an intelligent agent is a computational system located in an environment and that is able to behave in an autonomous and flexible manner in such environment in order to reach its designed objectives, it was decided to develop the gasoline blending optimization system as an intelligent agent.
Summarizing, there is evidence that the modeling of blend properties for an specific refinery using support vector machines, is a promising technique as the average error in our experiments is always below that obtained by conventional methods. Also, we can show that the agent developed and tested in this work can deal efficiently with the calculation of the specific optimization problems. In our experiments, a solution was always found and the convergence time was in the neighborhood of one minute. The agent was also tested in simulations to evaluate its capacity to deal with perturbations in the product quality during the blending process and the results are enticing. Based on conservative estimated explained in the paper, we estimate that, by using this intelligent agent for the on-line optimization of gasoline blending in a medium capacity refinery of the National Refining Circuit of PDVSA, the system could generate savings in the order of 5MM$/year.

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