

Blending Optimization in Traditional Diesel Oil Production in Indonesia

Rois Fatoni, Heni Fidyayuningrum, Kun Harismah and A.M. Fuadi

Department of Chemical Engineering
Faculty of Engineering
Universitas Muhammadiyah Surakarta
Surakarta, Indonesia
rois.fatoni@ums.ac.id

Abstract

There are many old oil wells in Indonesia which are no longer operated by the state-owned oil company Pertamina. Those wells have no longer a sufficient amount of oil to be extracted continuously. One such oil field is located in Wonocolo district, Bojonegoro in East Java Province. Local miners are allowed to operate oil mining by using very simple equipment. Currently, there are around 235 wells. Each well produces 300 to 350 barrels of crude oil per day and was operated two times a week. The crude was sold to Pertamina, but some of the crudes were processed by the miners by using a traditional distillation system called *pawon*. At least there are 190 *pawon* in the Wonocolo district. The crude is processed into diesel oil. The oil is sold to the market with a price of IDR 2,750. It is almost half of the price of the regular diesel oil sold by Pertamina, IDR 5,500 per liter. The objective of this study is to increase the quality of traditional diesel oil by applying simple blending operations. To achieve this objective, diesel oils produced by different *pawon* are treated as feedstock with different grades. Traditional diesel oil is divided into 3 (three) grades based on its density. To obtain the Cetane Index value, the density and the distillation profile of diesel oil is needed. The ASTM D1298 ASTM D86 methods were used to obtain the density and distillation profile of the diesel oil. Cetane Index calculation was carried out by using ASTM D976 and ASTM D4737. Blending is the process of mixing from several ingredients to obtain a new product which is in accordance with the desired specifications. Volume comparisons of blending can affect the quantity and quality of new products produced. The purpose of this study is to obtain the optimal condition of the Index of traditional diesel oil blended. The calculation results of the Cetane Index ASTM D976 are 50.66, 47.59, and 45.24 for Grade 1, Grade 2, and Grade 3, respectively. The calculation results of the Cetane Index ASTM D4737 are 47.04, 45.08, and 43.47 for Grade 1, Grade 2, and Grade 3, respectively. This information can be used to optimize the quality of the traditional diesel oil by diesel blending optimization. The optimization was carried out by applying response surface methods with design of experiment of three component mixture, i.e., the three grades of diesel oil. Determination of optimal conditions The Cetana Index was performed by using Design Expert software with Simplex Lattice Design with Mixture Design method. The optimum results were found and can increase the profit up to 66%.

Biographies

Rois Fatoni, Ph.D. is currently an Associate Professor of Chemical Engineering at the Faculty of Engineering Universitas Muhammadiyah Surakarta. He also serves as Dean of the Faculty of Engineering. Before, he served as Department chair in Chemical Engineering Department in the same Faculty between 2014-2021. He holds an undergraduate degree in Chemical Engineering Department of Faculty of Engineering, Universitas Gadjah Mada, Jogjakarta, Indonesia, a Master's in Environmental Process Design, The University of Manchester, U.K., and a Ph.D. degree in Chemical Engineering Program of University of Waterloo, Canada in 2012. During his PhD studies he was supervised by Professors Ali Elkamel and Leonardo Simon. His research interests include modeling, simulation, optimization, scheduling, process safety, mixture design, advanced materials, biomass, and innovative technology for medium-small scale industries.

Professor Kun Harismah, PhD received his BSc in Chemistry Education from IKIP Semarang, Indonesia; an MSc in Chemistry from the Universitas Gadjah Mada, Jogjakarta, Indonesia and a Ph.D. in Organic Chemistry from Sheffield University, U.K., in 2009. She served in the Department of Chemical Engineering, Faculty of Engineering Universitas Muhammadiyah Surakarta. She also served as chair of Intellectual Property Center of the University

(2017-now). She published numerous articles in refereed journal and conference proceedings. Her main interest is on the extraction and optimization of essential oils from various plants grown in Indonesia.

Ahmad M. Fuadi, Ph.D., is currently an Associate Professor of Chemical Engineering at the Faculty of Engineering Universitas Muhammadiyah Surakarta. He also served as Associate Dean (Academic) of the Faculty of Engineering (2009-2013), and Program Chair Chemical Engineering Master's Program in the same Faculty between 2014-2021. He holds his Bachelor, Masters and Doctoral Degree in Chemical Engineering from Chemical Engineering Department of Faculty of Engineering, Universitas Gadjah Mada, Jogjakarta, Indonesia. During his PhD studies he conducted his research on pulp and paper optimization production in Chemical Engineering Department of Chalmers University of Technology. His research interests include modeling, simulation, optimization, in pulp and paper technology.