Chapter 4

Implementation of Basic Principles of Econometric Analysis in Petroleum Technology: A Review of the Econometric Evidence

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Additional information is available at the end of the chapter

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Abstract

In the present study we give the opportunity to understand the physicochemical parameters of distilling petroleum products applying the basic principles of econometric analysis. The quality of the different fuels is expressed by a series of physical, chemical or other characteristics. The connection between production process and quality of fuel is crucial in the field of petroleum technology. It is remarkable that the used method of the regression analysis perfectly illustrates the relationships between the variables in all applied models. Econometrics is one the best methods to study the variation of the physicochemical properties of the oil. The use of econometrics methods in petroleum chemistry turned out to be useful tool in order to prove that there is indeed strong rates volatility and correlation between physicochemical properties of oils with their mixes. In Petroleum Industry the most common types of Diesel fuels are the biodiesel, biomass to liquid or gas to liquid Diesel. The results of our research can be an important tool for the development of software that can anticipate changes of physicochemical properties of petroleum distillate products, taking into account specific parameters.

Keywords: diesel, JP8, biodiesel, econometric, analysis

1. Introduction

Econometric applications are now accepted in order to have safe conclusions in oil technology as well. The use of such applications can provide the necessary information to deal with problems, particularly in terms of fuel quality. The forecast is based on mathematical equations that take into account specific fuel price constraints. In this way, it is possible to check the quality of the fuel during the production process and also the quality at its distribution points.

Econometric analysis is used in order to find out whether there is a relationship or not between particular variables. The relative evaluation realization demands the application of statistic and mathematic methods which are focused on the variables features used by the analysis.

The use of linear regression analysis is one of the most famous econometric methods. By using structure and unstructured data we can evaluate empirical research and taking into account the theory we can come up with safe conclusions [1]. An introductory economics textbook describes econometrics as allowing economists "to sift through mountains of data to extract simple relationships [2]. The first known use of the term "econometrics" was by Polish economist Pawel Ciompa in 1910 [3].

As already mentioned above the basic tool for econometric analysis is the linear regression method. With this model we can create models and come up to safe conclusions. The linear regression method can also be easily applied in the case of oil or pure diesel blends. In modern econometrics, other statistical tools are frequently used, but linear regression is still the most widespread method among all. Especially for the study of the physicochemical properties of the oil, meaning diesel and biodiesel, we are dealing with non-chronological data. Econometrics is one the best methods to study the variation of the physicochemical properties of the oil in order to draw strong and reliable conclusions about the quality of the examined mixture and in most cases to able to preview the values of its physicochemical property of the tested model fuels [4]. Estimating a linear regression on two variables can be visualized as fitting a line through data points representing paired values of the independent and dependent variables [4].

Greene [5] suggests that the environmental and energy issues increase the demand for different fuel types of altered and mixed oils. The market of petroleum products is enlarged as a consequence of the changes in the environment of life that have originated from the improvement of the living conditions, the cities expanding as a result of the massive population movement and the expanded basic needs.

Next to this, the national trade balance and the economic development are influenced by this compulsory demand since Greece imports more crude oil products owing to the expansive requirement. Additionally, the transportation energy use of diesel causes a serious environmental pollution by its gases, leading EU countries to command against them and avoid the bad side effects of the polluted environment that are greenhouse effect, acid rain and serious health issues.

So, all the referred arguments make the biodiesel an only-way solution that will replace the diesel oil as long as it is able to respond to the current increased needs of the means of transport and has also the diesel oil characteristics so as to meet the requirements of producing the appropriate energy. Its main features are to be mixable, efficient and stable unexceptionally [6]. Micro emulsions, thermal cracking (pyrolysis), transesterification (alcoholysis) are the basic four proper procedures of producing biodiesel and according to the usual course of things the direct utilization and mixing follows [7].

At this point we should refer that the transesterification of natural and fats oils is the method that is mainly used. So the application of alkalis, acids or enzymes facilitates the process since they implement the catalysis to the transesterification chemical reaction of triglycerides with alcohols (ethanol, propanol, methanol, amyl alcohol or butanol).

The researchers [8] attempt to succeed in defining the accurate new fuels characteristics based on the extracted equations by using the linear regression model which is the basic tool for econometrics. According to their findings, the performance of socially responsible firms is negatively related to an increase of global CO2 emissions. In addition, the methods of econometrics will be applied to the variables targeting to retrace the connection points between the mix and the fuels physicochemical properties in the tested models.

In other words with the use of econometrics methods they to prove that there is indeed strong rates volatility and correlation between physicochemical properties of oils with their mixes. This relationship can be represented by mathematical equations after the application of linear regression [9, 10].

Naturally, as far as mixes are concerned, the Y = ax + b is the suggestive linear equation that is capable of pointing variables reactions. The variables relation could be stated by the simple linear regression model as the following equation shows:

$$Y_i = b_0 + b_i X + U_t \tag{1}$$

where Y_i: i is the experimental value of the dependent variable physicochemical property as well.

X_i: i is the value of the independent variable Mix.

b_0, b_1: the straight regression coefficients.

U_t: the equation error.

Finally, the referred estimating process should be applied to fuels identified with similar properties under the advisable temperature that it must be followed at its experiment. The use of econometrics in order to study the physicochemical properties of the oil enables further investigation of the relationship between physicochemical properties in the same or different oil blends. Through the equations it possible to identify in advance where to be expected the change of values of the mixtures and to preview the values of the examined physicochemical properties.

The process of experimenting followed international standards as well as ISO procedures in order for the results to be right. By using econometric methods, the authors have demonstrated that there is a positive relationship between the model variables. The extraction of equations was the main econometric result of the authors' research.

2. Materials

Biodiesel is one of the most well-known and widely used fuels in the world [23]. Speaking about oil and specific for Diesel oil we must mention that in in general is any liquid fuel used in diesel engines. Essentially diesel fuel is a mixture of hydrocarbons which are come from petroleum. Petroleum crude oils are composed of hydrocarbons of three major classes: (1) paraffinic, (2) naphthenic (or cycloparaffinic), and (3) aromatic hydrocarbons. The most common types of Diesel fuels are the biodiesel, biomass to liquid or gas to liquid Diesel.

When we are using the word Biodiesel we first have to give the definition of a particular fuel type [24]. Biodiesel refers to clean burning renewable fuel made using natural vegetable oils and fats. Biodiesel can be used as an alternative solution of the petroleum, diesel fuel or in most cases can be blended with petroleum diesel fuel in any proportion. Of course, this particular type of fuel is used not only on engines but is it also applicable to other uses.

It is known that the process by which the biodiesel is produced involves the esterification of the mother oil (and/or fat) with methanol and with the catalyst. The result may include components such as the residual catalyst, which are not desirable. For example, the presence of glycerol, although separated during the production of biodiesel, is almost certain in the final biodiesel.

Jet Propellant 8 (JP8) is a kerosene based fuel which when blended with specific additives constitutes a suitable material for military applications. This type of fuel has previously been used as a fuel for aircraft. However, its capabilities have also led to its use for ground vehicles [11].

The main reason was that military forces like NATO and especially the United States of America decided to use a specific fuel for their transport and activities. JP8 consists by approximately 99.8% kerosene by weight and is a complex mixture of higher order hydrocarbons, including alkanes, cycloalkanes, and aromatic molecules. JP8 contains three mandatory additives: a fuel system icing inhibitor, a corrosion inhibitor, and a static dissipater additive.

It is also known that JP8 is a fuel that can easily be adapted to any requirements and applications. This is done by adding chemicals with antioxidants.

Its composition is a mixture of petroleum hydrocarbons. In general, the mixture is of the methane series and contains 10–16 carbon atoms per molecule. Of course, the presence of paraffin is a key ingredient in making it used as a fuel in jet engines.

A framework for analyzing unstructured data using statistical methods in order to verify the existence and the type of correlation between the blends pure Diesel and Biodiesel and the respective physicochemical property.

It is also noted, in nowadays, that the statistics science is based on the chemistry and chemical engineering issues, so the interconnection between the statistical models and methods and the chemical experiments is very obvious provided that the chemical experiments and data analysis use them as a guide in the framework of their researches.

Firstly, a significant presentation of this interrelation should take place, and then the calibration matter should be studied. Speaking specifically, the generalized standard addition method (GSAM) will be examined targeting the following areas: initially, the upgrading of statistics field and the future estimation theory and the multicomponent analysis development as well and secondly the registration of the statisticians character in order to achieve a constitutive communication and understanding between the sciences and scientists of the two fields.

During our research we made experiments in order to export a regression equation which describes the variation of the physicochemical property taking into account, in most cases, the parameter of time.

Throughout our experiments we studied the variation of humidity of Diesel fuel with Time [12]; the variation of kinematic viscosity in blends of Diesel fuel with Biodiesel [4]; the variation of humidity and reduction conductivity of JP8 (F34) with time [13]; the variation of heat of combustion in blends of Diesel fuel with Biodiesel [14]; the variation of density in blends of Diesel fuel with Biodiesel [15]; the variation of conductivity in blends of Diesel fuel with Biodiesel [8]; the contribution of different kinds of biodiesel on the conductivity and density of blends of diesel and biodiesel fuels (animal and vegetable) [16]; the variation of humidity of conventional diesel with time [17]; the variation of density of diesel-biodiesel blends across the scale (0–100)% by adding each time 2% biodiesel and then measuring the density of 3 different temperatures (5, 15, 25)°C [9]. The results of our research are based on tables and figures. All tables and related figures are available in the published papers.

3. Results and discussion

In order to determine the suitability of fuel and the reduction of pollutants to the environment, quality control of alternative fuels is considered to be necessary. What we can certainly find almost all of the fuel is the presence of water. In any case, its presence causes problems such as erosion. Our effort is to modify the percentage of dampness in diesel oil through an equation. The whole process involves introducing hydrophilic LPG polymers into diesel fuel samples. Monitoring the whole process resulted in the moisture content being recorded over a period of time, and based on these results, we created an equation. In all cases and throughout our experiment the volume of fuel and mass remain constant [18–21].

Specifically, in this paper we have examined the regression model that we can see below,

$$Y_i = b_0 + b_i \, Sin\,(T_i) + U_t \tag{2}$$

The adaptability and suitability of the prototype model was confirmed by the application of specific econometric controls. Specifically, we examined the adaptability of the standard residues and their squares in order to check whether or not they are free from serial correlation. We also tested the existence of first order autocorrelation using the Durbin-Watson index [22].

The time (T) and the change in humidity was a basic question that we wanted to answer with this research using the linear regression model. The results showed that the presence of moisture declined over time, even reaching its maximum value in the first hour. Essentially with this equation we can predict humidity values over a period of time. By applying this equation we can know when we can remove the greatest amount of moisture from the fuel.

In our next research we tried to export an equation which describes the variation of kinematic viscosity in blends of diesel fuel with biodiesel. Using specific volume of these blends we determine kinematic viscosity via method ASTM D 445-06 using a capillary glass viscometer in order to study the contribution of quantity of biodiesel and convert the statistical data into mathematic relation as a specific formula, attempting to achieve an empirical evaluation.

Trying to accomplish this, we studied the way how the values of variables are changed and whether a relation exist using dispersion diagrams [4]. From the graphic depiction realized that the relation is linear and they proceeded to regression analysis. The analysis extracted the conclusion that the relation was strong and the values of the dependent variable kinematic viscosity was depended on a large percentage of the values of the mixture of fuels.

As far as the mix is concerned, the authors expected that the upgrade of the animal and vegetable biodiesel would be proportional to the increase of the kinematic viscosity arithmetic outcome due to the linear relation that connects the two variables. Studying on the regression, the authors notice that Eq. (4) has correct signals as they are aware of theory, so that the bigger addition of biodiesel on pure diesel will make the mix quote lower and lower real values to kinematic viscosity. The authors came to the relative conclusion as it is defined by the following: $Y_i = b_0 + b_i X + U_t$.

Y_i: i is the observation of the dependent variable kinematic viscosity;

X_i: i is the observation of the independent variable mix;

b_0, b_1 are the straight regression coefficients and U_t represents the equation error.

$$Y_i = 40.914 + 0.0540\,X \tag{3}$$

We come to the conclusion that there is an actual strong linear relation that connects the above mix with the kinematic viscosity. It is remarkable that the mix independent variable has a strong linear relation to the Kinematic Viscosity. The autocorrelation heteroskedasticity absence that was combined to the strong linear relation of the variables made the authors to conclude that Eq. (3) is able to preview the kinematic viscosity of the model fuels [4].

In 2012, Tsanaktsidis et al. [13] showed that the proposed equation can predict the moisture content and the height of conductivity in JP8 (F34) fuel over time. Essentially an ingredient, called hydrophilic polymer, leads to the reduction or even the elimination of humidity over a certain time. For example over 39% of humidity and 36% conductivity are decreased over 2 hours. The elimination of humidity makes the fuel suit able for car machines and gives combustion with less pollution for the environment. Thus, the quality of the fuel as well as its combustion efficiency can be improved while the reduction of water concentration enhances the secure of the combustion machine's operation.

The preliminary statistical analysis of sequences of humidity Y and time T have shown that the modifications of Y, probably determined by the sine of T. Specifically, in this paper we have examined the regression model in order to investigate the relation between humidity of JP8 fuel and the time, when the volume of the fuel and the mass of the polymer maintain stable. Some diagnostic tests were performed to establish goodness of fit and appropriateness of the model. First, the authors examined whether the standardized residuals and squared standardized residuals of the estimated model were free from serial correlation. In addition, the independence of the standardized residuals was confirmed by the Durbin Watson statistics.

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$$Y_i = b_0 + b_i\, Sin\, (T_i) + U_t \quad (4)$$

More precisely, the results of the current investigation showed that the change of humidity could be described via a regression equation at which the dependent variable is the humidity change and the independent variable is the cosine of the time that the hydrophilic polymer TPA remains at the fuel. The results of the analysis showed that in the long run the presence of moisture decreases. In fact, it reaches its maximum value in the first hour. Hence, with the proposed equation, moisture rates can be predicted for a period of time. Eliminating work makes fuel more suitable for machines and polluting less the environment. Thus, the results of the present study give the possibility of humidity removal via the polymer TPA, which can be reduced [13].

Continuing our research and using specific volume of blends of Diesel fuel with Biodiesel we determined heat of combustion, in order to study the contribution of each kind of Biodiesel and we converted the statistical data into mathematic relations as a specific formula, attempting to achieve an empirical evaluation. The linear regression model was selected in order to correctly evaluate the values of the dependent variable (relative to the corresponding values of the independent variable). The preliminary statistical analysis of our series has led to the conclusion that the relation that links the variables of our model is linear [14].

We have created two blends which were blend 1, which referred to the pure diesel with the animal fats biodiesel and the blend 2 which referred to the pure diesel and the vegetable biodiesel. The two blends were studied in terms of the heat of combustion value in order to find the equation that might define the blends heat of combustion value. Studying on the regression, we notice that the Eqs. (5) and (6) had correct signals as the blend value increase should quote positively the heat of combustion variable.

$$Heat\ \ of\ \ Combustion\ \ 1 = \ \ 40.914 + 0.0540\ \ blend\ \ 1 \quad (5)$$

$$Heat\ \ of\ \ Combustion\ \ 2 = \ \ 39.297 + 0.062\ \ blend\ \ 2 \quad (6)$$

By studying the relationship of the variables initially with diagrams, we have concluded that the relationship between fuel (Diesel + Animal Fat Biodiesel = Mixture 1 and Diesel + Vegetable Biodiesel = Mixture 2) is linear. The strong linear positive relation of the variables made us conclude that the Eqs. (5) and (6) were able to preview the heat of combustion of the model fuels [14].

Furthermore Tsanaktsidis et al. [15] tried to export equations that would be able to describe the variation of density in blends of Diesel fuel with Biodiesel. Using specific volume of those blends, we determined density (while temperature maintain stable), in order to study the contribution of each kind of Biodiesel and we converted the statistical data into mathematic relations as a specific formula, attempting to achieve an empirical evaluation.

In that study [15] we used pure Diesel and two kinds of Biodiesel; Biodiesel by vegetables (vegetable oil fuel) and Biodiesel by animal fats. The total volume of each blend was 100 mL and in every measurement the volume of Biodiesel was changing. In the third blend the percentage of each kind of Biodiesel was 50% of the total volume of Biodiesel (for example 20% blend included: 80 mL Diesel, 10 mL Vegetable Biodiesel and 10 mL Animal Fats Biodiesel).

We measured density via the method ASTM D 1298-99 firstly in pure Diesel and then in all blends. The preliminary statistical analysis of the density series and the mix have showed that the variations of the variable den (ϒ) were defined by the rates of the variable mix (X) introducing linear equation for the three mix types that we took into account. We observe that Eqs. (2) and (4) has the appropriate signals as the mix rate increase should give plus rate to density variable.

The examination of the relation of the Diesel pure fuel to a specific mix ratio of fats and vegetable oils Biodiesel was implemented under stable climate conditions that were measured per mix in order to avoid the mistake risk of sample rate output. Eq. (7) that refers to the 1st mix (pure Diesel and vegetable oils biodiesel) attempts to explain the relation between the pure Diesel and the vegetable oils biodiesel, that were the Y and the X accounting the chemicals attributes of the variables that they express. We observed that the Eqs. (7) and (8) had the appropriate signals as the mix rate were increased should gave plus rate to density variable.

$$Density = 0.817461 + 0.00521 \;\; mix1 \;\; or \;\; Y = 0.817461 + 0.00521 \tag{7}$$

With reference to the 2nd mix (pure Diesel and vegetable oils biodiesel), the equation had the appropriate signals and the relation to the dependent variable were statistically significant for the 2nd fuel mix, on account of the reasons we have already referred.

$$Density = 0.830749 + 0.000312 \;\; mix2 \;\; or \;\; Y = 0.830749 + 0.000312 \tag{8}$$

For the 3rd mix (pure Diesel and aggregation of fats and vegetable oils biodiesel), the next equation were registered, which explained the linear relation of the model variable.

$$Density = 0.826332 + 0.000417 \;\; mix3 \;\; or \;\; Y = 0.826332 + 0.000417 \tag{9}$$

Based on the Eqs. (7), (8) and (9) we shown with can said that the dependent variable was statistically significant to each of the three mixes we have studied.

Taking into account the chemical features of the diesel fuels, fats and vegetable oils Biodiesel, and considering that the observation temperature is 15°C, we conclude that we might have high density predictability for all the mix types that we used [15] meaning the 1st the 2nd and the 3rd one. The equation application might only achieve quite perfect success in predicting the suitability of the final fuel in terms of the every time examined characteristic.

In our next research we tried to export a regression equation which describes the variation of conductivity in blends of Diesel fuel with Biodiesel. Using specific volume of those blends, we determined conductivity, in order to study the contribution of each kind of Biodiesel and we converted the statistical data into mathematic relations as a specific formula, attempting to achieve an empirical evaluation [8].

We used pure Diesel and one kind of Biodiesel; Biodiesel by Vegetables (soybean oil- vegetable oil fuel). Those samples met the specifications of Diesel fuel and Biodiesel Standards. The total volume of each blend was 100 mL (for example 20% blend included: 80 mL Diesel and 20 mL Vegetable Biodiesel) and in every measurement the volume of Biodiesel was changing.

Studying on the regression, we noticed that the Eq. (10) had correct signals. The bigger addition of Biodiesel on pure Diesel would make the mix quote lower and lower real prices to the Conductivity.

$$Conductivity = 1691.409 - 17.504\ \ mix\ \ or\ \ Y = 1691.409 - 17.504 \tag{10}$$

In the framework of our research on the fuels relation (diesel + biodiesel = blend or mix), we concluded that there were an actual strong linear relation that connects the above mix with the Conductivity. It was considerable that the mix independent variable has a linear relation to the Conductivity.

That model meaning Eq. (10) probably might give not give us secure conclusions because of the substantial part of the humidity in the conductivity factor. The humidity factor importantly influences the conductivity values so that an additional measurement will ensure the inferences in this research field.

One of the filed that needs more attention and further study is the contribution of different kinds of biodiesel on the conductivity and density of blends of diesel and biodiesel fuels (animal and vegetable). In the framework of this research we attempted to substantiate the existence and the type of the correlation between the blends of pure Diesel and Biodiesel (Vegetable and Animal Biodiesel) and the Density as well as the conductivity.

We decided to adopt for this purpose the Regression Analysis as the best model that would support this study. The basic target of this method was the potentiality of the precise evaluation of the dependent variable prices regarding the specific independent variables prices. The preliminary statistical analysis of the Density (Y_1) and the Conductivity (Y_2) with respect to the fuel volume fractions (X) (fuels) series has directly showed that the relation that connects each variable is linear [16].

Pure diesel and biodiesel (vegetable and animal) were used. Those samples met the specifications of diesel fuel and biodiesel standards described above. Eleven different blends were used. The total volume of each blend was 100 mL and in each blend the volume fraction of diesel/biodiesel was different (100% diesel, 90% diesel-10% biodiesel, 80% diesel-20% biodiesel, 70% diesel-30% biodiesel, 60% diesel-40% biodiesel, 50% diesel-50% biodiesel, 40% diesel-60% biodiesel, 30% diesel-70% biodiesel, 200% diesel-80% biodiesel, 10% diesel-90% biodiesel, and 100% biodiesel).

In this research we had six different blends of biodiesel. The mixes were studied in terms of their Conductivity and Density values in order to find an equation that shows the relationship between Conductivity and Density of the created mix as a function of the blend's constitution. As far as the produced mix is concerned, the "mix", our last assumption is that the upgrade of biodiesel (vegetable or animal or 50% vegetable with 50% animal biodiesel) would be proportional to the increase in Density and Conductivity due to the numerical result of a linear relationship between the two variables.

$$Density = 0.005mix + 0.8175 \;\; Y_1 = 0.005mix + 0.8175 \tag{11}$$

$$Conductivity = 844.55mix \;\; - 83.63 \;\; or \;\; Y_2 = 844.55mix - 83.63 \tag{12}$$

The tested model was statistically significant at 1% level and we came to the decision that the selected regression model for the above mixes were suitable to account for an important part of the Density and Conductivity variability. We proceed to a closer examination of blends of pure diesel with animal biodiesel. The mixes were studied in terms of the Conductivity and the Density. As far as the produced mix were concerned, the "mix", we expected that the upgrade of animal biodiesel would be proportional to the increase in Conductivity and also in Density due to the numerical result of a linear relationship between the two variables.

$$Desity = \;\; 0.004mix + 0.8215 \;\; orY_1 = 0.004mix + 0.8215 \tag{13}$$

$$Conductivity = \;\; 2.789mix - 29.364 \;\; or \;\; Y_2 = 2.789mix - 29.364 \tag{14}$$

The tested model was statistically significant at 1% level and we came to the decision that the selected regression model for the above mixes were suitable to account for an important part of the Density and Conductivity variability.

Throughout the rest of that paper [16], we continued to our analysis with the examination of blends of pure diesel with Biodiesel (vegetable 50% + animal 50% biodiesel). Due to the linear relationship between the two variables our regression analysis has shown that the Eqs. (15) and (16) had correct signals.

$$\begin{aligned} &Density = 0.005mix + 0.8149 \;\; or \;\; Y_1 = 0.005mix + 0.8149. \\ &Mix = Pure \;\; Diesel + Biodiesel \;\; (50\% Animal \;\; Biodiesel + 50\% Vegetable \;\; Biodiesel \end{aligned} \tag{15}$$

$$\begin{aligned} &Conductivity = 11.605mix - 178.4 \;\; or \;\; Y_2 = 11.605mix - 178.64 \;\; . \\ &Mix = Pure \;\; Diesel + Biodiesel \;\; (50\% Animal \;\; Biodiesel + 50\% Vegetable \;\; Biodiesel) \end{aligned} \tag{16}$$

The tested model was statistically significant at 1% and based on that procedure we are able to come to secure conclusions. Moreover with this procedure it is possible the further study of the biodiesel use with lower density and Conductivity. We consider that this scientific study can contribute to the today's industry sector in terms of the exploitation of the alternative biodiesel fuel. Finally due to fact that the biodiesel cost is lower than the pure diesel the utilization possibility in a wide range reduces the production cost and makes a final fuel product that is friendlier to the environment [16].

In our next research we studied the possibility of exporting a regression equation which could describe the variation of humidity of conventional diesel with time. A hydrophilic polymers TPA (Thermal Polyaspartic Anion) and natural resin from halepius Pines tree were used to eliminate humidity from conventional diesel. At both cases, where TPA as well as natural resin was used as additive, the hydrophilic polymers just blended, mechanically, with the diesel and after several mixing times were removed from this. The elimination of humidity made the fuel suitable for car machines and gave combustion with less pollution for the environment [17].

The preliminary statistical analysis of sequences of humidity Y and time T have shown that the modifications of Y, probably determined by the sine of T. Specifically, in this research we have examined the regression model

$$Y_i = \ b_0 + b_i \, Sin \, (T_i) + U_t \tag{17}$$

in order to investigate the relation between humidity of JP8 fuel and the time, when the volume of the fuel and the mass of the polymer maintain stable.

As far as for the statistical investigation for the variables like time T and resin we came to the conclusion that the relationship is not linear. So, in order to proceed our research we have examined the regression model $Y_i = \ b_0 + b_1(T_i) + b_2(T_i)^2 + u_t$ in order to investigate the relation between humidity (Y), Time (Ti) and Time 2 (Ti) and the result of our analysis have shown the following equation:

$$Humidity\left(\frac{mg}{g}\right) = \ 137.58 + 1.33Time + 0.004Time^2 \tag{18}$$

The results of the current investigation have shown that the change of humidity could be described via a regression equation at which the dependent variable was the humidity change and the independent variable was the cosine of the time that the hydrophilic polymer TPA remains at the fuel.

Thus, the results of this research [17] gave the possibility of humidity removal via the polymers TPA and RESIN. Hence the quality of the fuel as well as its combustion efficiency can be improved while significant problems can be avoided because of the presence of water in the combustion machine.

Moreover, the properties of the fuel were not influenced by the use of the polymer. Via the equation, the value of humidity in a fuel can be calculated in the frames of the experiment time scale, without the use of experimental process, only by maintaining the parameters of the experiment (temperature 25°C and polymer use) in the proposed proportion.

The present study also investigated how fuel's humidity changes by the time (T) that the resin mass remains at the fuel, using a regression model. Because of the nonlinear relation we can say with certainty that the humidity can be predicted with safety (almost 86% at the time) when using Eq. (18).

The use of biodiesel fuel is becoming increasingly imperative nowadays and it is necessary to know the change of density. In our next research we have studied the variation of density of diesel-biodiesel blends across the scale (0–100)% by adding each time 2% biodiesel and then measuring the density of three different temperatures (5, 15, 25)°C covering and the usual scale of temperatures the use of mixtures of diesel-biodiesel. Through the extraction of equations can be known in advance the relationship of density of diesel-biodiesel blend, and temperature that is used.

Based on these fuels created 50 diesel-biodiesel blends content (0-2-4-6 .... 100) % v/v, at three different temperatures (5, 15, 25)°C to cover all common temperature scale used diesel-biodiesel mixtures. Then we proceed to the determination of the density of these mixtures. The determination is conducted through the ASTM D-1298 method (ASTM D1298-99, 2005) with measurements by means of BS718:1960LSOSP hydrometers. These measurements are reduced to a temperature of 15°C, at which they also constitute the value of fuel density, while they are expressed in kg/L. The measurement scale of these hydrometers is between 0.6 and 1.1.

In order to verify the existence and the type of correlation between the blends pure Diesel and Biodiesel and the Density we decided to use the Regression Analysis as the best method that would support this study. The preliminary statistical analysis of the Density (Y) with respect to the fuel volume fractions (X) (fuels) series had directly showed that the relation that connects each variable were linear for its temperature meaning 5, 15 and 25°C [9].

In this research we had almost 50 different blends of biodiesel for its temperature. The mixes were studied in terms of their Density values in order to find an equation that shown the relationship between Densities of the created mix as a function of the blend's constitution. As far as the produced mix was concerned, the "mix", our last assumption was that the upgrade of biodiesel would be proportional to the increase in Density due to the numerical result of a linear relationship between the two variables. We came to the relative conclusion as it was defined by the following equations:

$$mix01 = 0.8114 + 0.0013 \ \ density \text{ Constant temperature } 5^{o}\text{C} \tag{19}$$

$$mix02 = 0.8282 + 0.001 \ \ density \text{ Constant temperature } 15^{o}\text{C} \tag{20}$$

$$mix03 = 0.8262 + 0.0008 \ \ density \text{ Constant temperature } 25^{o}\text{C} \tag{21}$$

The proposed methodology can be used in the bio fuels industry for the prediction of variation of the density of mixtures of diesel-biodiesel in a temperature scale is the most common in use for these fuels. Moreover based on this procedure we are able to come to secure conclusions when the values of density according to the mixes where measured between 5 and 25°C. If we overcome these limits then we will face autocorrelation and heteroskedasticity problems. In this case our model will have no predictive ability and will essentially reject as unacceptable [9].

4. Conclusion

Based on our results the variation of the physicochemical properties of the oil can be predicted. This can be done using the equations generated during our investigations. The predictive capacity of these equations is valid only if specimens and mixtures follow specific rules, such as those during the experiments we conducted. With these studies we came to the conclusion that it is given the opportunity to develop software in order to study the changes of physicochemical properties of petroleum distillate products. The development of such an application would help us to know in advance the variation of the physicochemical properties. This implementation would be important not only for researchers but also for the respective control bodies as regards the quality of the final product at each stage to the final consumer. Taking into account such equations and having knowledge of oil technology, we can predict the prices per fuel mix and, accordingly, accept it or reject it.

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