PETROCHEMICAL QUALITY MEASUREMENT AND ADULTERATION DETECTION USING ARM CONTROLLER

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***Abstract*— Now-a-days, measurement and the continuous monitoring of the petrochemical becomes essential due to the high competition in the industrial sector. Different parameters are need to be analyzed during the quality measurement and adulteration detection. In this project, the parameters like density, viscosity are measured by using experimental setup whereas parameters like humidity and temperature are measured by using sensors. The measured parameters are compared with the standard values of pure petrochemical. This comparison gives degradation in quality of petrochemical.**

This paper gives the detail about the easy and economic way to determine the adulteration in the petrochemical. Method used to determine the quality and the adulteration can be used at industry as well as end user level .

***Index Terms*—petrochemical, adulteration, quality, end user.**

I. INTRODUCTION

Where different product of comparable qualities have different prices or consumer have no efficient tools to distinguish similar product of different qualities, unscrupulous operators will always try to exploit the situation for the illegal profit. Fuel adulteration is one of the major abuses along with under dispensing product to customer. These practices lead to losses in several areas, which includes damaging engines and worsening air quality[3]. In India; the adulteration of gasoline (petrol) is normally indulge primary due to significant price differential between products.

Adulteration is define as the illegal or unauthorized introduction of foreign substance into petrochemical or similar substance, with the result that the product does not confirm to the requirements and specification of the product.

To determine the adulteration in the petrochemical, quality determination is necessary. Different parameters affect the quality at different extent. Adulteration causes the degradation in the standard value of the parameters. Therefore it is necessary to measure the different parameters.

To measure the quality of the petrochemical, different parameters have to be examined such as Density, Viscosity, Temperature and Humidity. For this, there are different laboratory methods are available. This paper provides the measurement of all this parameters simultaneously with simple approach. By measuring all the parameters, the quality and the adulteration can be detected through this project.

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II. PROCEDURE

A. Density Measurement

Liquid density is an important characteristic used to provide information concerning composition, concentration, mass flow in fuels, and caloric content[1].

Density of the substance is the relationship between the mass of the substance and how much space (Volume) it takes up. It is also most prevalent physical property used to classify and characterize liquids.

Density is expressed as mass per unit volume but is often expressed in terms of specific gravity (SGliq), which is the ratio of the liquid density to the density of water both taken at the same temperature and pressure.

Mass (m) is a fundamental measure of the amount of matter. Weight (w) is a measure of the force exerted by a mass and this force is produced by the acceleration of gravity. Therefore, on the surface of the earth, the mass of an object is determined by dividing the weight of an object by 9.8 m/s2 (the acceleration of gravity on the surface of the earth). Since we are typically comparing things on the surface of the earth, the weight of an object is commonly used rather than calculating its mass.

The density (d) of a material depends on the phase it is in and the temperature. (The density of liquids and gases is very temperature dependent.) Water in the liquid state has a density of 1 g/cm3 = 1000kg/m3 at 4o C.

The density of the liquid is mathematically expressed as

$$d = density = \frac{W2 - W1}{V}$$

where,
W1 = weight of the empty specific gravity bottle. (in gm)
W2 = weight of the specific gravity bottle with liquid. (in gm)
V = Volume of the specific gravity bottle. (in ml)

Density of good quality diesel will be between 812 to 814gm/m3 whereas, petrol of good quality have value of 803 gm/m3 .

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B. Viscosity Measurement

Viscosity is a internal property of a fluid that offers resistance to flow. Higher the viscosity thicker the liquid, lower the viscosity thinner the liquid[7]. But it is difficult to calculate with the higher accuracy using the conventional methods at the user level.

Viscosity is measure of the internal friction of a fluid.

The greater the friction ,the greater the amount of force required to cause this movement, which is called shear.

The viscosity is mathematically expressed as,

$$n = F/S$$

Where,

F= shear stress unit of measurement is dynes per square centimeter(dynes/cm2).

S = shear rate unit of measure is reciprocal second (sec-1).

Viscosity of oil is measured in two ways , based on kinematic viscosity and dynamic viscosity. The kinematic viscosity of the liquid which is calculated using density is mathematically expressed (in poise) as

$$n = viscosity = \frac{d2}{d1} \times \frac{tm2}{tm1} \times ndw$$

where,

d1 = density of the liquid to be measured. (in gm/ml)

d2 = density of the distilled water as a reference. (in gm/ml)

tm1 = mean time to flow the liquid in capillary tube between two reference points. (in sec)

tm2 = mean time to flow the distilled water in capillary tube between two reference points. (in sec)

ηdw = viscosity of the distilled water = 1 poise (standard).

Kinematic viscosity of the liquid can be measured using the special shaped viscosity tube shown in fig.3

C. Humidity and Temperature

Humidity is the amount of water vapour in the air. Water vapor is gaseous state of water and is invisible. Humidity can easily measure by using sensor like SYHS220. It converts relative humidity into output voltage.

Temperature sensor LM35 is precision indicator circuit. Its output voltage is linearly proportional to the centigrade. The practical range of LM35 is -55 to +155 centigrade. It operate from 4 to 30V with linear scale factor of 10mV/◦C.

Corresponding output is given to the ARM controller to determine the quality parameters.

D. Adulteration Detection

Adulteration detection can be determined by comparing the test results with standard reference using ARM Controller. ARM Controller displays the result on the LCD.

III. EXPERIMENTAL SETUP

A. Block wise System Representation

Block diagram below gives the overall representation of the system. ARM processor gives the comparison and the total outcome of the system about the quality and the adulteration of the liquid under test.

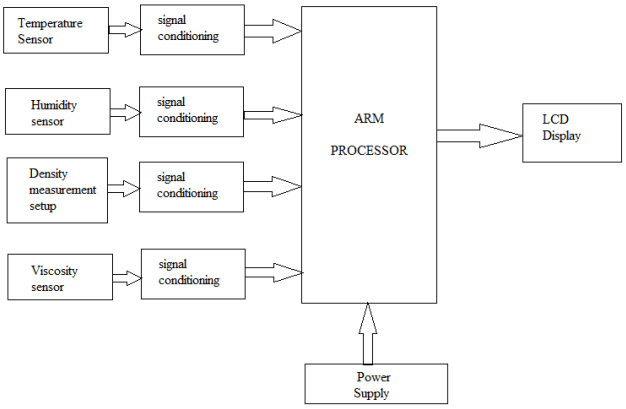

Fig.1 Block Diagram

B. Density measurement setup

To determine the density of the liquid, mass and volume can be determine. Initially the specific gravity weight of the fixed volume bottle can is measure using the weighing machine having high accuracy. Then weight of bottle along with liquid is measured.

The difference between the two gives the specific gravity weight of the liquid.

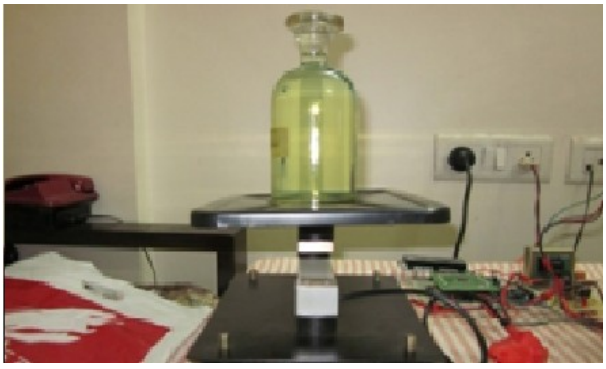

Fig.2 Density Measurement setup

Specific gravity weight divided by the fixed volume gives the density of the liquid. This is compared with the standard value to determine the quality and adulteration.

C. Viscosity measurement setup

Fig. 3 below shows the setup for the viscosity measurement. To determine the viscosity of the

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petrochemical, liquid is passed through the special shaped glass tube which is fitted with LED-LDR coupling which acts as a sensor to determine the flow of liquid through the glass tube.

Upper mark and Lower marks are acts as a reference points. Time required to flow through the reference points gives the mean time to flow the liquid through the capillary tube(Tm).

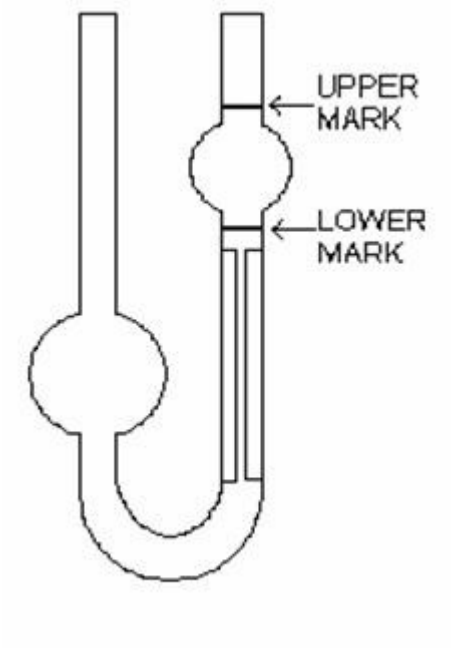

Fig. 3 Viscosity measurement setup

Internal oscillator measures the time duration between the two reference sensors and gives the detailed about the time duration to the controller.

D. Adulteration Detection

Adulteration is detected by comparison with the standard value given in the table below.

No.	Diesel and Kerosene proportion	Density at 27◦C (g/ml)	Kinematic Viscosity (cst)
1	Pure Diesel	0.8456	2.91
2	85:15	0.8400	2.33
3	75:25	0.839	2.16
4	65:35	0.8321	1.89
5	50:50	0.8292	1.75

Fig. I Standard Value of Density and Viscosity of Diese [6]

For the petrol, standard value of the density at room temperature is 0.700 g/mL.

By comparing with the above value the adulteration can be determine. The result are comparatively too clear to observation and gives the appropriate results about the adulteration in the petrochemical.

IV. RESULTS

A. Results for Density measurement

Liquid	W1	W2	Density (gm/ml)
Petrol(25 ml)	29.58	45.86	0.74
Petrol(50 ml)	16.59	55.42	0.76
Diesel(25 ml)	29.58	50.56	0.83
Diesel(50 ml)	16.59	60.24	0.87

Fig. II Density Measurement

B. Results for Viscosity measurement

		Viscosity	
Temperature	Humidity	Petrol	Diesel
28	20	2.12	2.42
32	40	2.08	2.34
36	59	2.00	2.27
40	60	1.95	2.24

Fig. III Viscosity Measurement

C. Results for Adulteration Detection

For the liquid with adulteration like petrol with kerosene give the results as below.

Liquid under test	*Density*	*Viscosity*	*Result on LCD*
Diesel	*0.84*	*2.42*	*pure*
Diesel with kerosene	*0.82*	*1.75*	*Adulterated*
Petrol	*0.7*	*2.12*	*Pure*
Petrol with kerosene	*0.66*	*1.89*	*Adulterated*

Fig. IV Result Table

V. CONCLUSION

This liquid density detection device has the features as follows: the volume is small, the structure is simple and the Performance of anti-interference is very strong. It is able to detect the density of liquid. The results show that this density detection device meets the actual needs, and has a high application value.

There is a concerted effort by several automobile manufacturers as well as numerous military and commercial vehicle manufacturers and end-users to develop a reliable, affordable, and meaningful in situ oil condition monitor. Along with the quality measurement, adulteration detection also done to great instant by this project.

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