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Fluids Adulteration Identification based on Resistive and Capacitive Variations

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Abstract—*In this paper we calculate the adulteration of the fluids in terms of resistance and capacitance. This adulteration helps in calculating the quality, odor, mixture ratio and originality of the fluid. We have analyzed four different types of mixtures i.e. Engine oil in edible oil, Kerosene in petrol, Kerosene in diesel and Water in milk. Furthermore, we calculate the resistive & capacitive variation of the mixture to get these adulteration values. These values may be utilized to improve the quality of fluids at various levels. Simulation performed using LCR meter confirms these calculations presented in this work.*

Keywords: *Sensors, LCR meter, Capacitance, Adulteration.*

1. INTRODUCTION

As Industrial revolution increases, the pollution in air has been increased due to abandoned use of fossil fuels and organic substances. It is fact that, fuel oil has been mainly used by the automobile industries and it contribute maximum amount of air pollution. These automobile industries are expected to grow in upcoming years at a very fast rate in the developing countries like China, India and Brazil, consequently air pollution increases at similar rate. Greenhouse gases and toxic gases has been emerged and leads to global warming, because the automobiles industries emit a huge amount of these gases and it create the essential problem for the environmental air. Adulteration of automobile fuels i.e. gasoline and diesel, leads to enlarged tailpipe emanation and the subsequentharsh effects on public health.

The primary cause of adulteration is the greed fueled by differential tax system [2,4-5]. For example, in south Asia, gasoline is taxed most heavily, followed by diesel, kerosene, industrial solvents and recycled lubricants, in that order. The fact that adulteration of gasoline by diesel and that of diesel by kerosene, is difficult to detect, combined with the differential tax structure makes such adulteration financially alluring, even though it is illegal. Mixing kerosene with diesel does not lead to an increase in tailpipe emission, but contributes to air pollution indirectly in South Asia. The diversion of kerosene for adulteration drastically brings down its availability, to the poor households, who turn to bio-mass for the purpose of cooking. This leads to an increase in the indoor air pollution and consequent ill effects on health. For the prevention of adulteration, monitoring of fuel quality at the distribution point, therefore, is highly essential.

In the Indian context, the mixing of diesel is used to adulterate the gasoline and kerosene is mixed to adulterate the diesel. This is because these types of adulterations are difficult to detect by the automobile user [3]when limited to small volume percent of mixing. The expected adulteration percentage is 10 % to 30 % by volume in both the cases. Less than (10%) adulteration is financially unattractive, while more than 30% adulteration is likely to be easily detected by the user from the degradation of the engine performance caused by the adulterated fuel [6].To check the adulteration effectively, it is necessary to monitor the fuel quality at the distribution point itself. The equipment for this purpose should be portable and the measurement method should be quick, capable of providing test result within a very short time. The measuring equipment should also be preferably inexpensive (as a large number of such units would need be simultaneously deployed) and easy to use.

Remaining part of this paper is organized as follows. Section II discusses the methods for estimation of fuel adulteration. Simulation results are discussed in section III. Lastly, paper concludes in Section IV.

2. METHODS FOR ESTIMATION OF FUEL ADULTERATION

LCR meter is a device which has been used to determine the values of Inductance 'L', Capacitance 'C' and resistance 'R' for any device associated with it. This device gives more easy and accurate readings in evolution of components such as capacitors, transformers, inductorsand electromechanical devices. The measurement condition is important for R&D in any specific test by LCR meters.

At low frequencies, electrical properties are measured by LCR meter with Auto balancing bridge method and at the same time at high frequencies engage the RF I-V method. In Fig. (a) auto balancing bridge method, in this test device under test (DUT) is placed in a bridge. The impedance of the device is represented by Z_x. The impedance Z_1, Z_2 are known, and Z_3 is changed until no current flow through D i.e. the terminals of D are made equi-potential or show null. Z_{DUT} is then calculated using the equation -

$$Z_{DUT} = \frac{Z_1}{Z_2} Z_3$$

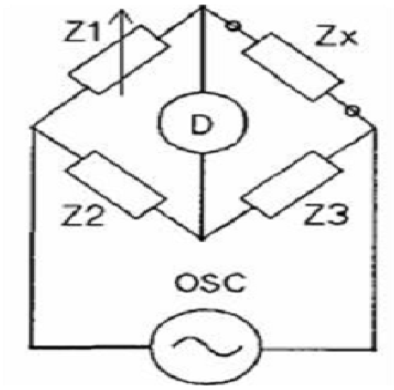

Fig. (a)Principal Diagram of Auto balance Bridge

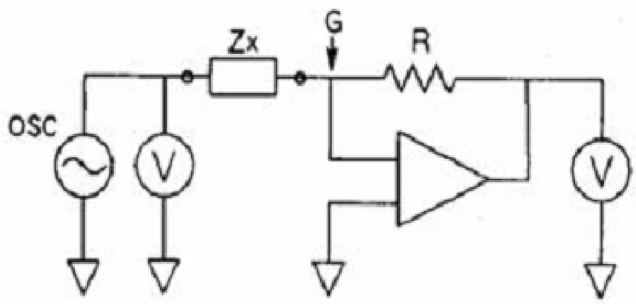

Fig. (b) The auto balance bridge method of I-V Curve

One terminal of DUT is at virtual ground. The current flows through the resistance R as shown in Fig. (b) until the current flowing through Z_{DUT} cannot go through the operational amplifier. The voltage drop over R can determine the current flowing through R. Having both the voltage over Z_{DUT} (Osc) and the current throughZ_{DUT}, the voltage of Z_{DUT} can be calculated using Ohm's law.

3. EXPERIMENTAL RESULT AND DISCUSSION

We setup an arrangement like balancing bridge and measure the resistance and capacitance of the adulterated liquid and finally lead to the impedance of the liquid and calculate the phase angle with voltage and current. Here, we discuss the result of various liquids one by one and gives the table and graph of the readings of LCR meter.

3.1 Adulteration of waste engine oil in Edible oil

In this liquid we mix the waste engine oil with the edible oil in varying percentage and calculate the reading as shown in table and Fig.

Fig. 1 shows the resistance variation with the mixing percentage of waste engine with edible oil and the Table-1 shows all other variation with respect to this adulteration.

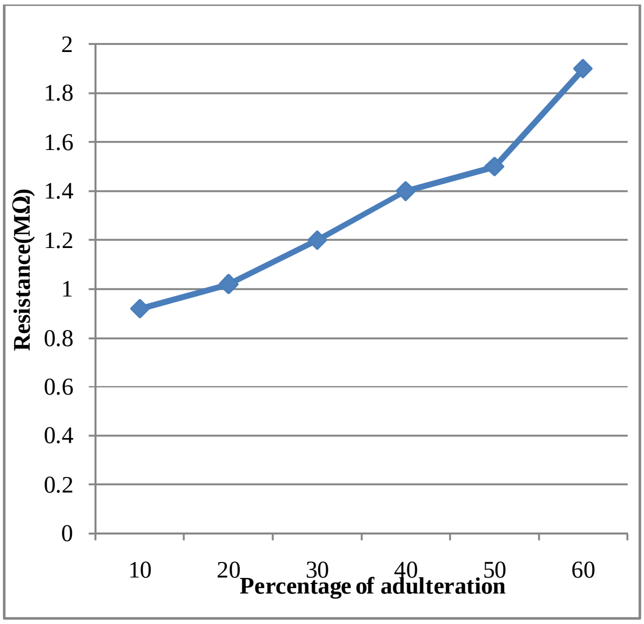

Fig. 1: Resistance vs. % adulteration of waste engine oil in edible oil

As we see in Fig. 1 the resistance of the edible increases as the mixing of waste oil increases so we can analyses that the conductivity of the oil decreases and efficiency reduces.

Table 1: Parameters readings with variation of waste engine oil

S .No	% of engine oil	Resistance(MΩ)	Capacitance(pF)	Impedance(MΩ)	Phase angle (degree)
1	0	0.83	18.7	8.5	84.5
2	10	0.92	19.3	8.3	83.7
3	20	1.02	20.8	7.7	82.3
4	30	1.2	21.2	7.5	80.7
5	40	1.4	21.8	7.4	79.2
6	50	1.5	22.4	7.2	79.1
7	60	1.9	25.2	6.6	73.3

3.2 Adulteration of Kerosene in Petrol

In this liquid we mix the kerosene oil with petrol in varying percentage and calculate the reading as shown in table and Fig.

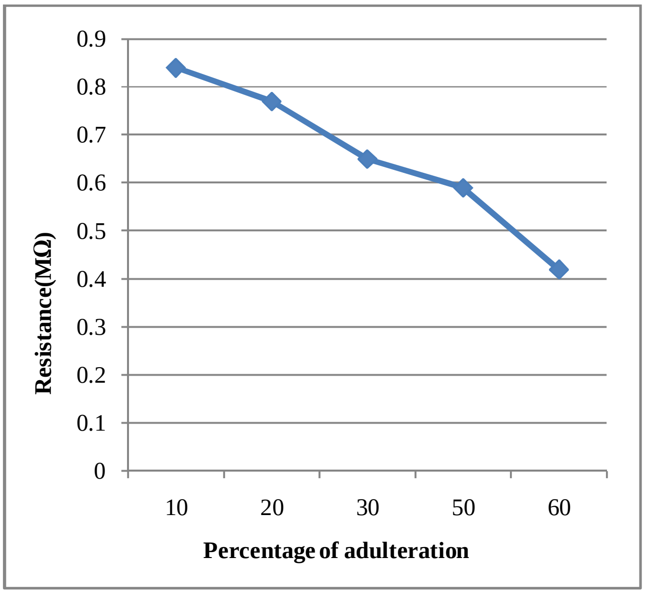

Fig. 2: Resistance vs. % adulteration of kerosene in petrol

Fig. 2 shows the resistance variation and Table-2 shows other parameters variations with the mixing of kerosene in petrol. Here resistivity decreases as we increase the kerosene percentage because viscosity of kerosene is less in compared to petrol so resistivity increases and conductivity decreases.

Table 2: Parameters readings with variation of kerosene

S. No	% of kerosene	Resistance(MΩ)	Capacitance(pF)	Impedance(MΩ)	Phase angle (degree)
1	0	0.95	15.9	10	84.5
2	10	0.84	15.1	10.3	85
3	20	0.80	14.8	10.8	85.6
4	30	0.77	14.4	11	86.1
5	40	0.65	15.1	11.2	86.5
6	50	0.59	15.3	11.7	86.8
7	60	0.42	15.6	11.9	87.6

3.3 Adulteration of Kerosene in Diesel

In this liquid we mix the waste kerosene oil with the diesel in varying percentage and calculate the reading as shown in table and Fig.

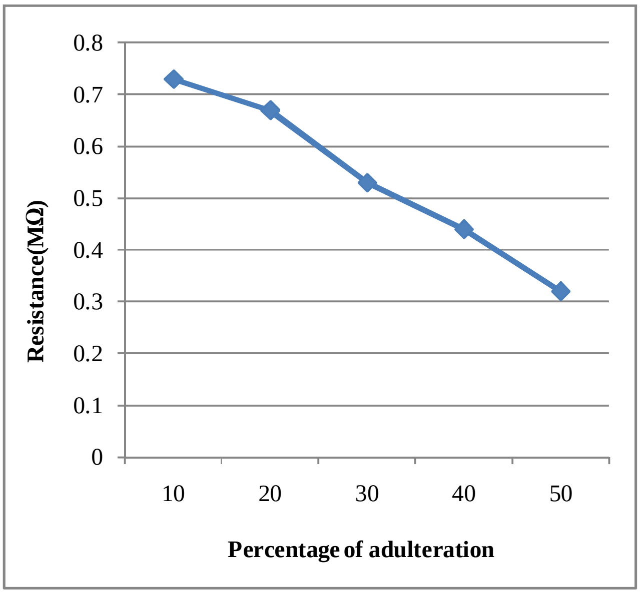

Fig. 3: Resistance vs. % adulteration of kerosene in Diesel

Fig. 3 shows the resistance variation and Table-3 shows the other parameters variation with respect to adulteration of kerosene oil in Diesel. Here, resistance decreases due to less conductive diesel in comparison of petrol in Fig. 2.

Table 3: Parameters readings with variation of kerosene

S. No	% of kerosene	Resistance(MΩ)	Capacitance(pF)	Impedance(MΩ)	Phase angle (degree)
1	0	0.82	15.6	10.2	85.4
2	10	0.73	15.1	10.4	86.1
3	20	0.67	14.8	10.7	86.5
4	30	0.53	13.8	11.6	87.4
5	40	0.44	13.3	12	87.9
6	50	0.32	13.5	12.1	88.5

3.4 Adulteration of Water in Milk

In this liquid we mix the water with milk in varying percentage and calculate the reading as shown in table and Fig. Fig. 4 shows the resistance variation and Table-4 shows the other parameters variation with respect to adulteration of water in milk.

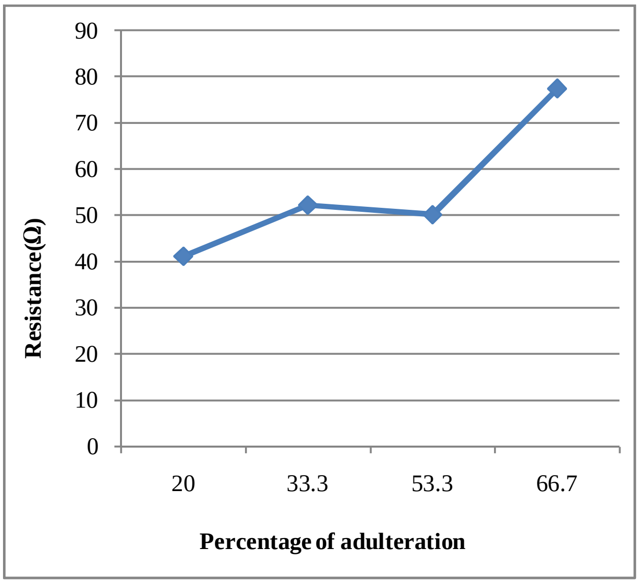

Fig. 4: Resistance vs. % adulteration of water in milk

The resistance is increased at some level and constant at some level due to percentage ofwater in milk in between 35% to 55%. The properties of milk do not change and gives the same resistivity.

Table 4: Parameters readings with variation of water

S. No	% of Water	Resistance(Ω)	Capacitance(μF)	Impedance(Ω)	Phase angle (degree)
1	0	52.6	2.7	77.4	47.2
2	20	41.1	3.7	59.6	46.3
3	33.3	52.2	4.3	63.9	35.4
4	53.3	50.1	5.3	58.1	30.5
5	66.7	77.4	5.4	82.8	20.9

4. CONCLUSION

The impedance's and phase angle of various fluids are discussed. These impedance's and phase angle gives the quality check of the fluid. And determine how much any fluid is more resistive and capacitive as compared to the pure one. We can easily determine the efficiency increment or decrement of that liquid and this is mankind application for the world.

Furthermore, this result gives the typical range of mixed liquid which gives the more accurate calculation of the pure liquid in a wide range. Careful mixing of fluid and use of data sheets gives good result. More future studies are needed to investigate the role participated by percentage of adulteration in liquid. Hence LCR meter gives the investigated the adulteration in liquids at a wide range with good results.

REFERENCES

[1] VelosoFransico, Kumar Rajeev "The Automotive Supply Chain: Global trends and Asian Perspectives" ERD working paper series no. 3, Economics and Research Department, Asian Development Bank-2002.

[2] World Bank report (July 2002) "South Asia Urban Air Quality Management Briefing Note no. 7", July 2002.

[3] N.K.L. Wiziack, A. Catini, M. Santonico, A. D'Amico, R. Paolesse, L.G. Paterno, F.J. Fonseca, C. Di Natale, "A sensor array based on mass and capacitance transducers for the detection of adulterated gasolines", Sensors and Actuators B 140 pp. 508–513, 2009.

[4] World bank report "Abuses in Fuel markets", viewpoint note no. 237, available September 2001.

[5] World bank report "Transport Fuel Taxes and Urban Air Quality", Pollution Management in Focus Discussion Note No. 11, Dec. 2001.

[6] G.Rajakumar, Dr.D.Manimegalai, "VLSI Implementation of DIP Based Edible Oil Adulteration Identification", International Journal of Advanced Research in Computer Science and Software Engineering, Volume 3, Issue 5, May 2013