Examining the Properties of Natural Ester Oils with Antioxidants and Nano Powders for Power Applications

K. S. Lincy, S. Senthil Kumar, M. Willjuice Iruthayarajan

Abstract: ***In this cutting edge world, electrical vitality is the significant thing to make due on the planet. An ongoing examination has prevailed that the oil by items are accessible just for not many years. Along these lines, following barely any years substitution of mineral oil is vital because of its debasement of protection. In this paper, the oil picked is Neem oil, sunflower oil, Mahua oil and Rice grain oil is treated with antioxidants(cancer prevention agents) and nano powders. "Breakdown voltage, flash point, fire point, viscosity and acidity are estimated in consonance with principles". To diminish the oxidation security normal and manufactured antioxidants(cancer prevention agents) are liked, and Nano powders are additionally utilized for improving the properties of the oil. Engineered cell reinforcements, for example, Beta Carotene and TBHQ and selenium are favored as normal cancer prevention agents. When the expansion of cancer prevention agents and nano powders the estimations were finished. After cancer prevention agents and Nano powders are included, the property of the transformer oil is expanded. By doing this investigation, the transformer oil is utilized for reuse reason and it has a more extended lifetime.***

Index terms: Antioxidants, Acidity, Break down Voltage, Flash Point, Fire point, Nano powders, Viscosity

I. INTRODUCTION

Transformer oil is used for insurance reason. It is gotten by oil results in this manner it is named as mineral securing oil. Transformer oil fills fundamentally two needs one it is liquid insurance in electrical power transformer and two it scatters warmth of the transformer that is it goes about as a coolant. It moreover helps in another two reasons, one to secure the middle and winding as these are totally doused inside oil, and next preventing the prompt contact of air oxygen [1].

Naphtha oil gets more successfully oxidized than Paraffin oil. Seepage plan present in the naphtha oil is more when stood out from paraffin oil [2]. Appropriately sludge isn't confined in the base of the transformer and doesn't furious the cooling game plan of the transformer. Yet, because of Paraffin oil regardless of the way that the oxidation rate is lower. In spite of the way that Paraffin-based oil has a shortcoming since we use it because of its straightforward availability. High pour point issue is found in paraffinic oil on account of the wax content, anyway this doesn't impact its use in view of warm air territory of India [3-5].

An Antioxidant is the concoction mixes which can defer the beginning or moderates the pace of lipid oxidation response in nourishment frameworks both normal and manufactured cell reinforcements are utilized in the nourishment business as nourishment added substances. Oxidative degeneration is expressed to have been brought about by unsafe particles called free radicals. Free radicals are atomic parts having at least one unpaired electrons [6-8].

Nanopowders are characterized as powdered materials with singular particles having sizes less than 100 Nanometers. The particles present in the nanopowders are extremely littler when contrasted and the wavelength of unmistakable light [9-10]. The littler size of nanopowders gives them an amazingly high surface territory to volume proportion that outcomes in unprecedented properties like outrageous quality. Underneath recipe is utilized to ascertain the quantity of nanoparticles to be included with the oil for planning of nanofluids:

Weight of the nanoparticles = (density * Volume) / (Volume Fraction).

II. EXPERIMENTAL PROCEDURE

The methodology includes standards, measurements, sample description and sample preparation. Sample description and sample preparation are done for Neem oil, sunflower oil, Mahua oil and Rice bran oil.

A. Standards

The measurement of oil properties like Viscosity, Breakdown Voltage, Acidity, Flash and Fire point is carried out according to IEC and ASTM standards [11-13]. The method standard used and standard values are given in Table 1.

Table -1: Standards and Methodology for Measurement

Parameters	Method/Equipment	Standard
Breakdown Voltage	Breakdown Voltage Kit	IEC 60156
Viscosity	Redwood Viscometer	ASTM D-445

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Flash Point and Fire Point	Pensky Martin Closed Cup Method	ASTM D-93
Acidity	Color Chart	-

B. Measurement of Breakdown Voltage

The dielectric quality of transformer oil is otherwise called the Breakdown voltage of transformer oil. The low estimation of BDV demonstrates the nearness of dampness substance and leading substance in the oil. In BDV unit, oil is kept in a pot in which one sets of the terminal is fixed with a hole of 2.5mm between them [14]. By raising the voltage estimation is taken 3 to multiple times in a similar example of oil. The breakdown Voltage testing unit is appeared in Fig.1

Fig. 1 Breakdown voltage test kit

C. Measurement of Viscosity

In fact the consistency of the oil is a proportion of the oil protection from shear. Consistency is all the more generally known as obstruction stream. The estimation of thickness the protection from stream between the individual layers [15]. A high thickness infers high protection from stream while a low consistency shows a low protection from stream. Consistency differs conversely with temperature [21].

D. Measurement of Flash and Fire Point

Flashpoint of an unpredictable fluid is the most minimal temperature at which it can disintegrate to shape an ignitable blend in air. Estimating a fluid's flashpoint requires a start source [16]. The blaze point is regularly utilized as one illustrative trait of fluid fuel, however it likewise used to portray fluids that are not utilized deliberately as fills [21].

The temperature at which the fume keeps on consuming subsequent to being lighted is called fire point. It is the most minimal temperature at which, on further warming past the blaze point the example will bolster ignition for 5 seconds. The Pensky Martins Closed Cup mechanical assembly is appeared in Fig.2.

Fig.2. Pensky Martin Closed Cup Apparatus

E. Measurement of Acidity

The acidity is determined by utilizing shading outline technique. 1.1ml of the oil test and 1ml of ethyl liquor are blended and subsequent to shaking admirably 1ml of sodium carbonate is included [17-20]. After re shaking great 5 drops of all inclusive marker arrangement is included and blended well. By utilizing the shading graph corrosive substance in oil test is found in KOH/g.

F. Sample Preparation

The Neem oil, sunflower oil, Mahua oil and sunflower oil of 500 ml is blended in with the single and mix cell reinforcements like TBHQ, selenium, beta carotene and BHT and nano powders like aluminum nitride, carbon nanopowder and calcium phosphate are blended utilizing attractive stirrer unit for 30 minutes under 750 RPM.

Table -2: Sample Preparations

Sample	Sample Name
1	500 ml of Base fluid
2	500 ml of base fluid +1g TBHQ
3	500 ml of base fluid +1g Selenium
4	500 ml of base fluid +1g Beta Carotene
5	500 ml of base fluid + 1g BHT
6	500 ml of base fluid +0.5g Selenium +0.5g Beta Carotene
7	500 ml of base fluid + 0.5g Selenium +0.5g TBHQ
8	500 ml of base fluid + 1g calcium phosphate
9	500 ml of base fluid + 0.5g TBHQ +0.5g Beta Carotene
10	500 ml of base fluid + 0.33g Selenium +0.33g Beta Carotene+0.33g TBHQ
11	500 ml of base fluid +1g Aluminum Nitride
12	500 ml of base fluid +1g Carbon Nano Powder
13	500 ml of base fluid +0.5g Carbon Nano Powder+0.5g Aluminum Nitride

III. EXPERIMENTAL STUDIES

The experiments are conducted from the combination of Neem Oil, Sunflower Oil, Mahua Oil and Rice Bran Oil blended with regenerative materials. The critical parameters of the samples are improved and discussed in below.

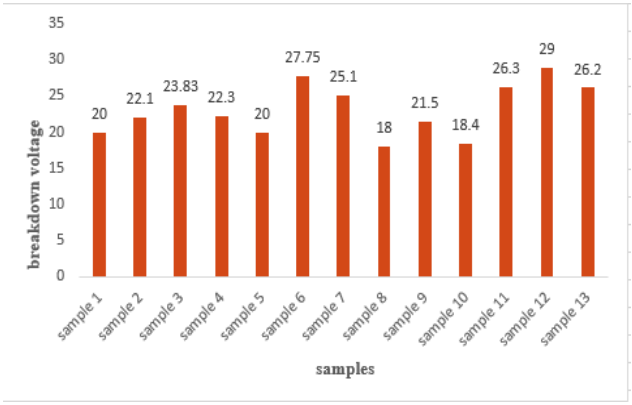
A. Merger of Neem Oil with Regenerative Materials

The assessment of basic parameters of Neem Oil by method for various extents through expansion of regenerative materials like TBHQ, Selenium, Beta Carotene, Aluminum Nitride and Carbon Nano Powder were made.

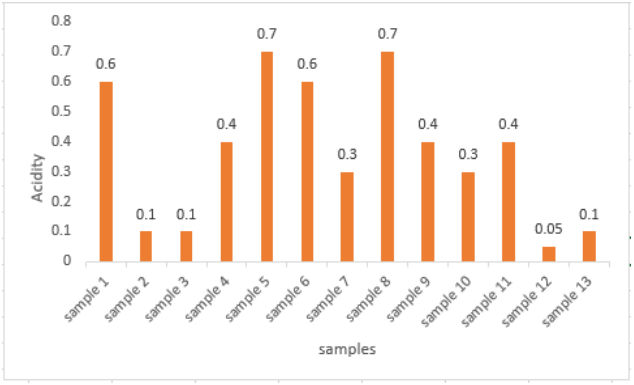
Table 3 shows the after effects of Neem Oil blended in with regenerative materials. The graphical portrayal of correlation of Breakdown Voltage and sharpness estimations of tests utilizing Neem oil are appeared in diagram 1 and 2

Table-3: The Blending of Neem Oil with Regenerative Materials

Sample	BDV (kV)	Viscosity at		Point (^{0} C)		Acidity (KOH/g)
		40^0 C	90^0 C	Flash	Fire	
1	20	145.81	41.05	230	250	0.6
2	22.1	113.23	34.10	260	283	0.1
3	23.83	94.95	34.10	238	257	0.1
4	22.3	110.10	34.90	243	259	0.4
5	20	370	120	250	265	0.7
6	27.75	82.40	28.40	218	238	0.6
7	25.1	48.50	14.52	232	248	0.3
8	18	280	127	220	240	0.7
9	21.5	87.11	28.40	243	261	0.4
10	18.4	94.43	30.58	253	274	0.3
11	26.3	86.33	28.13	283	300	0.4
12	29	97.04	26.49	279	296	0.05
13	26.2	74.81	24.28	273	295	0.1



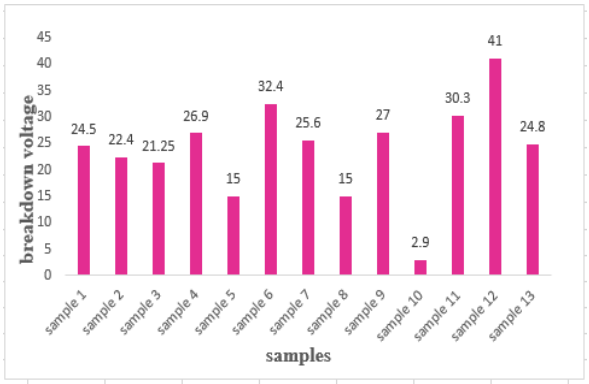
Graph 1. Relationship of Breakdown Voltage using Neem oil.



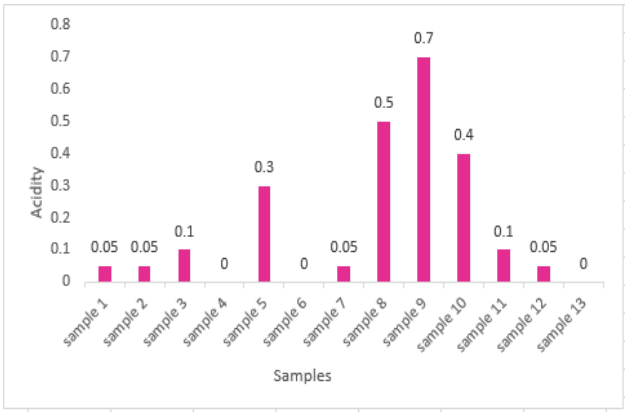
Graph 2. Relationship of Acidity using Neem oil.

B. Merger of Sunflower Oil with Regenerative Materials

The assessment of basic parameters of Sunflower Oil by method for various extents through expansion of regenerative materials like TBHQ, Selenium, Beta Carotene, Aluminum Nitride and Carbon Nano Powder were made. Table 4 shows the consequences of Sunflower Oil blended in with regenerative materials. The graphical portrayal of examination of Breakdown Voltage and acridity estimations of tests utilizing Sunflower Oil are appeared in chart 3 and 4.



Graph 3. Relationship of Breakdown Voltage using Sunflower oil



Graph 4. Relationship of Acidity using Sunflower oil.

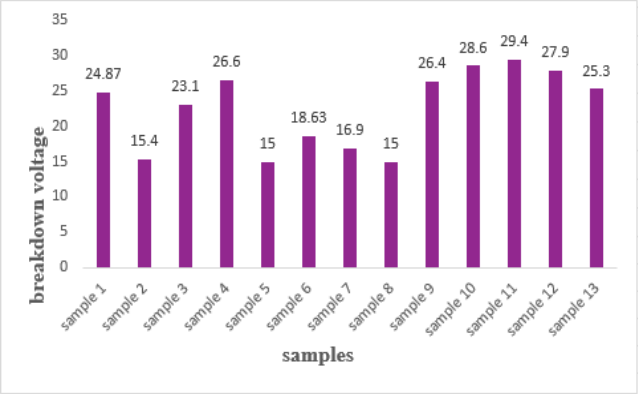
Table-4: The Blending of Sunflower Oil with Regenerative Materials

Sample	BDV (kV)	Viscosity at		Point (^{0} C)		Acidity (KOH/g)
		40^0 C	90^0 C	Flash	Fire	
1	24.5	42.66	26.21	>300	>300	0.05
2	22.4	115.31	52.46	>300	>300	0.05
3	21.25	90.51	25.66	>300	>300	0.1
4	26.9	75.85	26.21	>300	>300	0
5	15	285	135	250	275	0.3
6	32.4	84.49	30.04	>300	>300	0
7	25.6	90.25	26.21	>300	>300	0.05
8	15	300	180	270	290	0.5
9	27	48.50	23.72	>300	>300	0.7
10	20.9	90.51	55.1	>300	>300	0.4
11	30.3	70.87	25.94	>300	>300	0.1
12	41	66.15	20.93	>300	>300	0.05
13	24.8	91.55	23.17	>300	>300	0

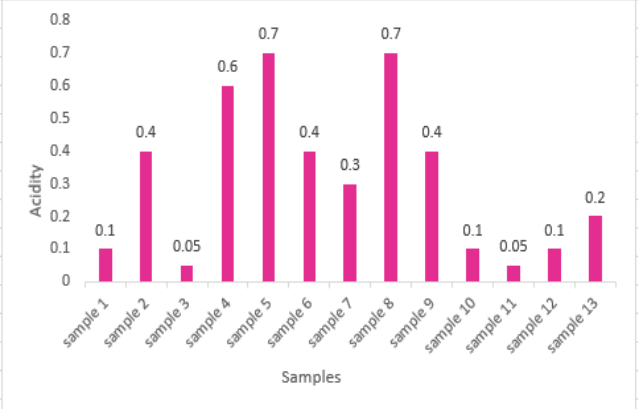
C. Merger of Mahua Oil with Regenerative Materials

The assessment of basic parameters of Mahua oil by method for various extents through expansion of regenerative materials like TBHQ, Selenium, Beta Carotene, Aluminum Nitride and Carbon Nano Powder were made. Table 5 shows the aftereffects of Mahua oil blended in with regenerative materials.

The graphical portrayal of examination of Breakdown Voltage and sharpness estimations of tests utilizing Mahua oil are appeared in chart 5 and 6.



Graph 5. Relationship of Breakdown Voltage using Mahua oil.



Graph 6. Relationship of Acidity using Mahua oil.

Table -5: The Merger of Mahua Oil with Regenerative Materials

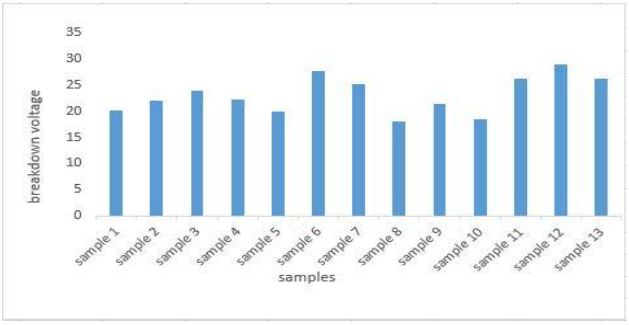
Sample	BDV (kV)	Viscosity at		Point (^{0} C)		Acidity (KOH/g)
		40^0 C	90^0 C	Flash	Fire	
1	24.87	298.53	30.85	270	290	0.1
2	15.4	80.83	30.58	240	260	0.4
3	23.1	81.88	37.85	250	268	0.05
4	26.6	96.52	27.04	258	273	0.6
5	15	285	135	250	275	0.7
6	18.63	115.05	28.13	252	269	0.4
7	16.9	103.57	30.04	280	298	0.3
8	15	300	180	270	290	0.7
9	26.4	98.35	27.04	275	294	0.4
10	28.6	123.39	31.39	>300	>300	0.1
11	29.4	109.31	46.37	290	>300	0.05
12	27.9	108.27	22.89	268	291	0.1
13	25.3	183.22	56.42	285	>300	0.2

D. Merger of Rice Bran Oil with Regenerative Materials

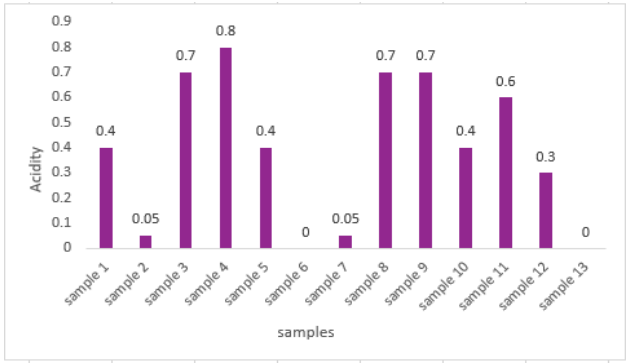
The assessment of basic parameters of Rice grain oil by method for various extents through expansion of regenerative materials like TBHQ, Selenium, Beta Carotene, Aluminum Nitride and Carbon Nano Powder were made. Table 6 shows the aftereffects of Rice wheat oil blended in with regenerative materials. The graphical portrayal of examination of Breakdown Voltage and acridity estimations of tests utilizing Rice grain oil are appeared in chart 7 and 8.

Table -6: The Merger of Rice Bran Oil with Regenerative Materials

Sample	BDV (kV)	Viscosity at		Point (^{0} C)		Acidity (KOH/g)
		40^0 C	90^0 C	Flash	Fire	
1	35	285	120	340	355	0.4
2	20	400	120	340	360	0.3
3	30	370	150	280	330	0.7
4	25	480	110	220	250	0.8
5	25	210	110	320	335	0.4
6	20	350	100	315	320	0.4
7	25	365	115	290	325	0.6
8	15	340	135	320	330	0.7
9	25	395	138	315	335	0.5
10	30	380	135	300	330	0.6
11	25	465	225	300	320	0.6
12	20	390	130	280	320	0.3
13	28	385	130	320	330	0.4



Graph 7. Relationship of Breakdown Voltage using Rice Bran oil.



Graph 8. Relationship of Acidity using Rice Bran oil.

IV. RESULT AND DISCUSSION

In this work, Neem oil, Sunflower Oil, Mahua oil and Rice Bran oil are mixed in different proportions with Antioxidants and Nano Powders. From Tables 3, 4, 5 & 6 we observe that the BDV, Flash Point and Fire point temperatures have decreased and increased considerably with minimum and maximum change in the viscosity after addition of the Selenium, TBHQ, Beta Carotene, Aluminium Nitride and Carbon Nano powder. From the results, it can be shown that after contacting the Neem oil with regenerative materials the Breakdown Voltage is increased from 184.4 kV to 29 kV. The Flash Point is increased from 218^0C to 283^0C and the Fire Point is increased from 238^0C to 300^0C. The viscosity value gets decreased in 40oC and 90^0C temperatures. Due to the mixture of Sunflower Oil with regenerative materials the Breakdown Voltage is increased from 21.25 kV to 41 kV. The Flash Point is greater than 300^0C for all samples and the Fire Point is greater than 300^0C. The viscosity value gets decreased in 40^0C and 90^0C temperatures. Due to the combination of Mahua Oil with regenerative materials the Breakdown Voltage is increased from 15.4 kV to 29.4 kV. The Flash Point is increased from 240^0C to 300^0C and the Fire Point is increased from 260^0C to 300^0C. The viscosity value gets decreased in 40^0C and 90^0C temperatures.

V. CONCLUSION

Transformers are the most important part in the electrical force framework. The investigation is utilized to set up the resurgence of vegetable oil. In addition the mix of cancer prevention agents (TBHQ, Selenium, BHT, Beta Carotene) and Nano Powders (Aluminum Nitride, Calcium phosphate, Carbon Nano Powder) is a demonstrated method for improving the properties of vegetable oil. The significant highlights of utilizing cell reinforcements and nano powders blend during experimentation separated from upgrade property are exceptionally less carbon content during breakdown. After the expansion of regenerative materials, the parameters, for example, BDV, Viscosity, Flash point and Fire point gets expanded. This methodology is in addition expensive in evading unsafe transfer of utilized transformer oil to condition. By and large inspection infers that the upgraded oils utilizing regenerative materials, nano powders and cancer prevention agent is a fitting answer for potential reuse in power transformer.

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