IMPROVEMENT OF SOLAR PV UNIT COMPETENCE THROUGH NEEM OIL AS COOLANT

Abstract

The Solar PV cells are used to convert the sunlight into electricity and Sunlight radiation also have heat which is reduced to efficiency of the panel. The heat should be controlling the limited value or otherwise reduced the performance of the panel so that, heat is move to the cooling medium thus maintaining the heat in functioning limit. The proposed method is explained in the probability of cooling themonocrystalline and polycrystalline structure is used as neem oil throughincorporatedoilcontainer fitted into backside of the unit. The neem oil is not polluted the environment, thus also used to exchange noxious mineral oil. The neem oil moved from depository tank to backside of the unit and together in an additional depositor tank, thus be able to reuse. The proposed method is detailed investigated and functioning comparison takes place different PV type such as monocrystalline and polycrystalline module with various kind of edible oil. Thus, the important outcomes of method are decrease the panel temperature and enhance efficiency of the PV panel. The viscosity and calorific value are important parameter of cooling oil.

Keywords: Solar PV, Waste Neem Oil, Cooling, Efficiency.

Authors

M. Saravanapandian
Department of ECE
PSR Engineering College
Sevalpatti, Sivakasi
Virudhunagar, India.
saravanapandian@psr.edu.in

S. Athimoolam
Department of ECE
PSR Engineering College
Sevalpatti, Sivakasi
Virudhunagar, India.
athimoolam@psr.edu.in

L. Manoharan
Department of ECE
Hindustan Institute of Technology and Science
Padur, Chennai, India.
manoharanekk@gmail.com

S. Sivakumar
Department of ECE
Bharath Institute of Higher Education and Research
Selaiyur, Chennai, India.
sivacud@gmail.com

I. INTRODUCTION

The occurrence sunlight of able to be seen wavelength upper limit is 1200nm and lower limit is 400nm are immersed with the solar panel and transformed into electrical energy. The occurrence solar light also has a heat this increases the panel temperature. The real time competence of the mono crystalline unit is 12-18%, respected to the lab competence of 25% [1, 2]. In ref, [3], the novelist experiential so as to the standard competence have mono crystalline & polycrystalline unit throughout summer reductions through 20.1% & 19.6%, compared to wintertime.

The burning dry area, the functioning heat as PV be able toward amplify up to 81°C [4]but in the steamy area, amplify further than the functioning limits, thus give on to thermal deprivation and decrease in competence [5]. The deprivation in the exchange competence of 0.51% reduces occurs for each0.9°Cincrease[6, 7]. In adding together, to amplify in functioning heat, partial shading and hot-spotinfluence the competence [8-13]. In a series connection cells have partial shading ;thus, cell operate to the load so that losses the power as heat. Thus, kind of problem is overcome by connecting bypass diode transversely to series linked cells [9, 14]. The warm-plug decreases on competence& produce warm air pressure happening as compartment thus dropping on consistency of the arrangement [9]. Consequently, the situation is very important toward remove temperature as of the PV cell. The temperature generates in the unitbe able todecreased by means of wind or liquid by way of a cooling materials a srearon front age exterior.

In wind-cooled solar arrangements are cast-offon different and economical resolution to construction an incorporated arrangement. The wind hole connecting the unit and rooftop is able touse for circulate the wind to reduce the temperature of PV unit and preheated wind be able touse for construction thermal needs. [15, 16] To analysis the construction-incorporated PV arrangement and used the usual wind to reduce the temperature of the unit. The wind run is determined by the temperature and wind-produced force among the apex and base of the space. Likewise, numerous methods such as fins [17], matrix [18], and crowded wind flow way [19] has used as cooling medium of the PV unit.

In Ref [20] considered the process of dropping the indication on the PV unitby means of a layer (0.9 mm) of operation water on the front age exterior of the unit. The outcomes how amplify in functioning of 10.6% in excess of the day. In Ref [21] investigated the functioning of the PV arrangement by give water on the higherexterior of the unit. The investigated confirmation is to amplify of 16% in the competence at tipe mission circumstances. In Ref [22] better-quality the functioning on solar water drive arrangement withs cattering water in excess on front agee xterior of the unit. The novelist establishesso as to the spraying aquatic to the front age exterior decreases the indication and heat of the PV panel. In Ref [23] analysis the functions of the unitflooded in water and improved the competence of the arrangement.

Together wind and water are able to use as a cooling intermediate to move the temperaturegenerate by the unit. On the other hand, the PV arrangement by means of water as a cooling intermediate is additional competentas compared with airowing towards its high value thermosubstantial belongings. [24].

The mineral oilis used as a cooling intermediate for the move to producenoxiousmatterowingtoward oxidative unsteadiness. Themethod of tools breaksdown; the removal of inorganicoilsremainshard. The outflow of inorganicoilsbe able toreasona severehazard to the atmosphere. Consequently, silicon oil is used as another to mineral oilcontaina high value flash factor; it is additionalcostlyand not well for environment. Hence, vegetable oilbe able used as an exchange cooling intermediate for transferable, thus isobtainable highly, inexpensive, renewable, recyclable and safe one. Vegetable oil is triglyceride extractas ofvegetation or the seed andturn out to befluid at room hotness [25].

In this examine, this inspection be used waste edible oil such as peanut oilcast-offas the temperature transportliquid to upholdonnecessaryfunctioningheat of the unit. The edibleoil has benefitted concentrationowingtowards its accessibility, reuse environment friendly, less hazards and small in fluencehappening the atmosphere [26]. Vegetable has enhanced thickness, flash factor, dielectric power and secure flamesbetterto mineral exchange oils (peanut oil) intimated in Table 1. Depend shappening the final use of vegetable oils are intimated as edible oil.

The arrangement of the manuscript is prepared as addressed part 2 explains the investigational setup designed for solar PV schemelacking and by means ofthe cooling preparation. Part 3 explains the outcome and talk for investigationalexamination of peanut oil as temperature move fluid beside through a conclusion in part 4.

II. INVESTIGATIONAL SETUP

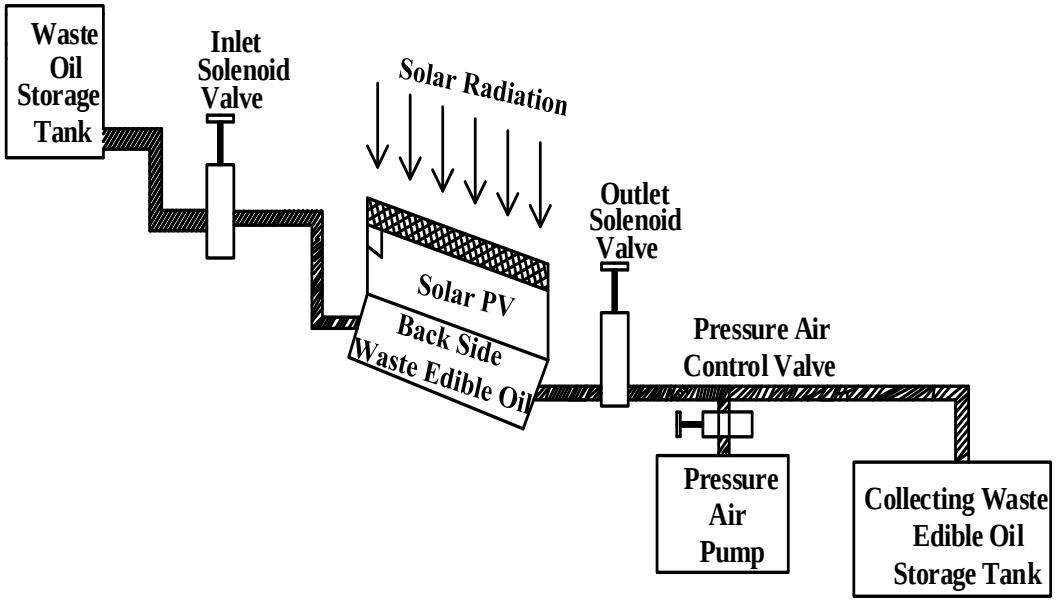

Figure 1: Representation diagram of the proposed system

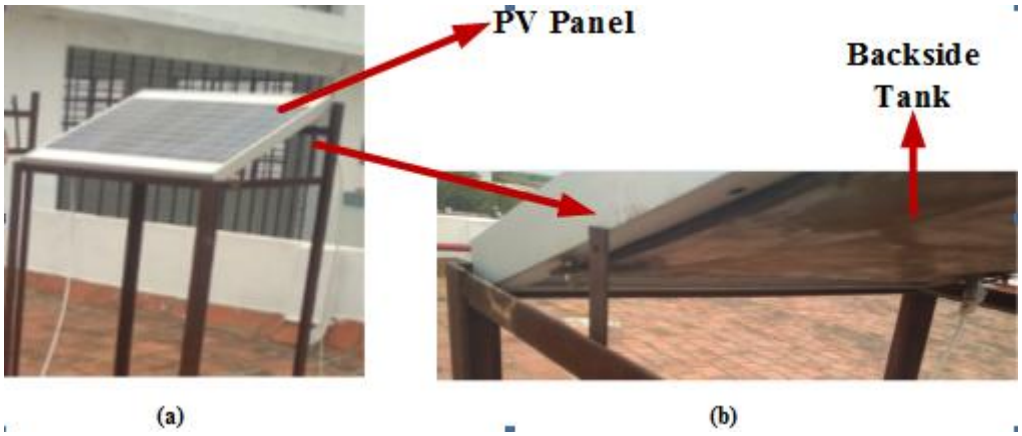

Figure 2: (a) Solar unit with a cooling preparation **(b)**Rearlubricant tank

Figure. 1 shows the representation diagram of the proposed system. The construction of solar unit, waste oil depositary tank, rearoil tank incorporated through PV unit, force air drive, and oil tank for bring together waste oil. The functioning onsolarunitby way ofa purpose of eatableoil cooling bean investigation with viaa monocrystalline and polycrystalline unit (17-inch × 14-inch) not including and including cooling partbesidethroughrearagreementoildepositary tank of 16inch × 13 inch × 1.6. The investigational setup (Figure2)isdesigned at the rooftop of the KCET(9.6728° N, 77.9659° E). Theoccurrence sunlight and heat of the PV unitarecalculatedwith the solar indicator. Together the unitconstruct of oil-incorporated tank fittedtowards the rearof PV unit for interesting the temperatureas of the unit and thus uphold the necessary functioning heat. The waste edible oil (peanut lubricant) remains deposit to depositarytank;the situation is approved to run from end to end the oil tank partinside the rear on PV unit. In regulator wheel the oilrun keen on the unitin addition toaway of the unit. Thus, excited oil is together on depositary tank. The functioninginvestigation onmono crystalline and polycrystalline unitnot including in addition to including oil cooling actions is behaviour through edible oil similar to peanut oil (05.04.2020)since coolant.

Table 1: Substantial belongings of edible oil [27, 28]

Requirement	Thickness (g/ml)	Kinematic Viscosity @40 °C (mm^2/sec)	Thickness Index	Saponification Value	Iodine Value	Pour Factor °C	Flash Factor °C
Peanut oil	0.914	36.84	144	184-195	84-95	3	336

III. RESULTS ANALYSIS

Peanut oil: The highest sunlight of 940W/$m^2$is inward at 01.00 P.M, lowest amount sunlight of 80W/$m^2$is inward at 6.00 P.M and standard sun light in ward all the way through the daylight (05.04.2022) is 633 W/m^2. The highest ambient heat is 41.4^{o}C evidence at 01.00 P.M, least amount ambient heat is 26.4^{o}C establish at 09.00 A.M and standard heat throughout the daylight is 32.83^{o}C (Table 2).

Figure. 3 intimates the force of peanutoil cooling lying on unitheatall the way through the daylight. The highest, smallest amount and standard unitheat for the monocrystalline unit not including cooling is 68.5^{o}C, 30.3^{o}C and 51.3^{o}C and including cooling, is 66.3^{o}C, 28^{o}Cand 49.19^{o}C correspondingly. The peanut oilsincethe coolant has outcomewithinastanddecreaseof the monocrystalline unit and polycrystalline unitheatas2.29% and 04.34%correspondingly.

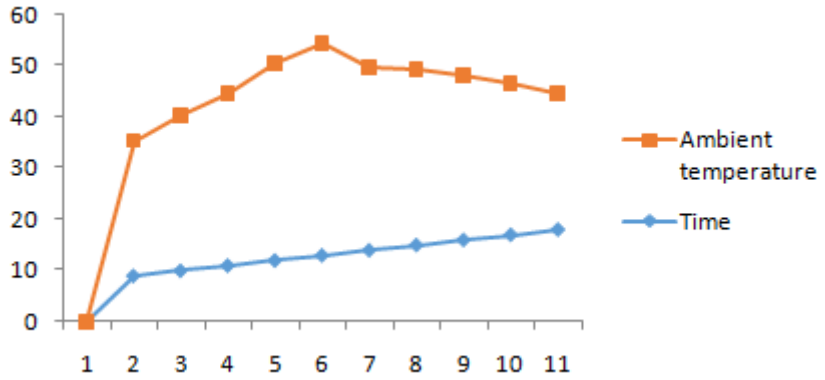

Figure 3: Unit temperature for peanut oil as a coolantthrough time

Figure. 4 intimates on difference of sunlight with respect to time. The greatest and smallest amount sunlightoccurson 01.00 P.M and 06.00 P.M. The unitheat amplify with amplify in sunlight.

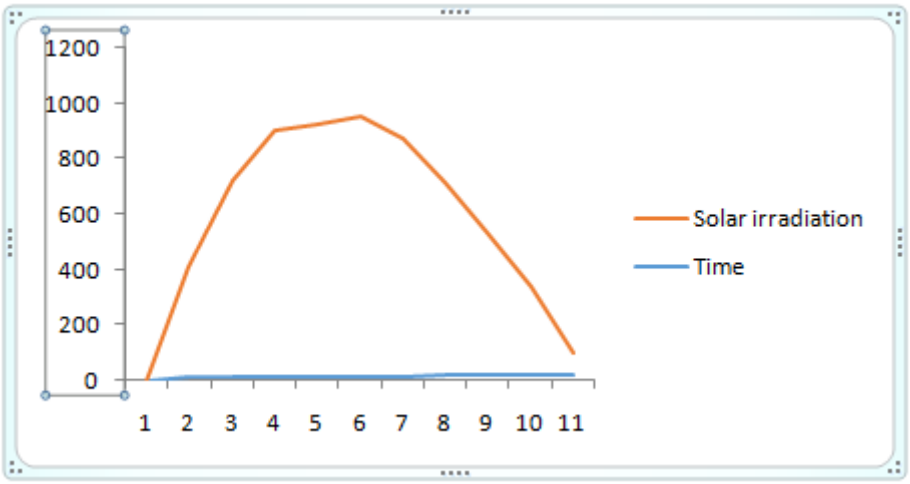

Figure 4: Solar irradiation for peanut oil as a coolant through time

In highest, value of competence for monocrystalline unit not including and including cooling is 11.6% and 12.8% experiential at 10.00 A.M. likewise for polycrystalline unit not including and including cooling is 12.9% experiential at 10.00 A.M and 19.8% at 6.00P.M. Consequently, the monocrystalline and polycrystalline unit contain improved the standardcompetencetowards15.0% and 17.8% through the cooling unit.

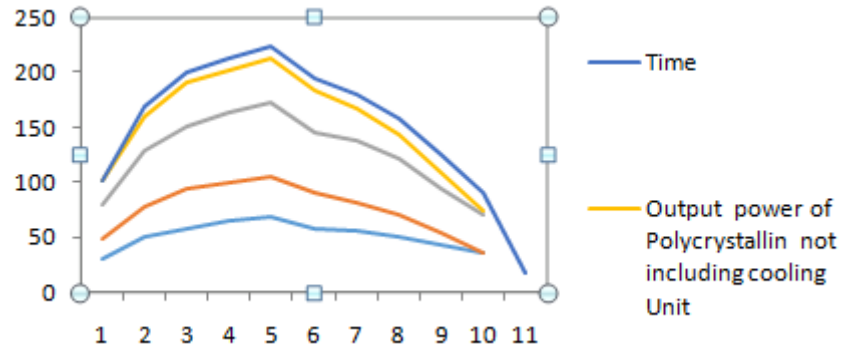

Figure 5. Output power for not including cooling unit through time

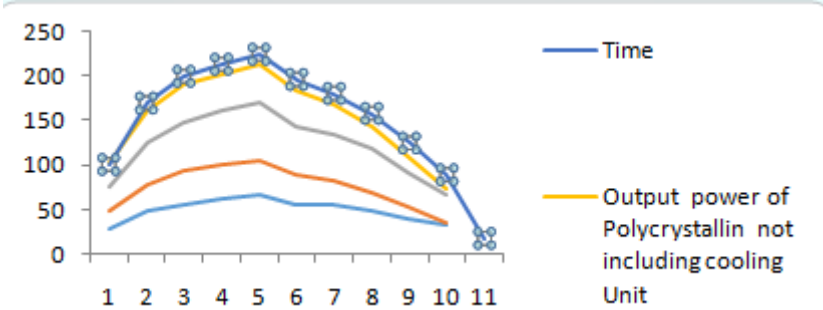

Figure 6: Output power for including (Peanut oil as a coolant)cooling unit through time

Table 2: Peanut oil as a coolant

Time	Solar irradiation	Ambient temperature	Monocrystalline unit not including cooling arrangement		Polycrystalline unit not including cooling arrangement		Monocrystalline unit including cooling arrangement		Polycrystalline unit including cooling arrangement	
			Module temperature	Output power	Module temperature	Output power	Module temperature	Output power	Module temperature	Output power
9	400	26.4	30.3	19.1	29.9	22.1	28	21.1	27	25
10	710	30.3	50.2	29.2	49.1	31.2	48.3	31.3	47.2	34.3
11	890	33.7	57.2	37.1	56.9	38.9	55.1	39.3	54.9	40.9
12	910	38.4	64.2	36.2	63.1	38.6	62.8	38.4	61.2	40.4
13	940	41.4	68.5	37.3	67.1	39.4	66.3	39.9	65.2	41.6
14	860	35.6	56.7	34.2	55.1	37	54.7	36.2	53	39.8
15	700	34.2	56.3	26.6	55.2	28.9	54.2	28.7	53.1	30.9
16	520	32	51.1	19.6	50.3	22	49	21.7	48.2	24.6
17	320	29.6	42.7	11.4	41.2	14	40.2	13.6	39.1	16.3
18	80	26.7	35.8	1	34.1	4	33.3	2.2	32	5.1

I. SUMMARIZE OF FUNCTIONING ON PEANUT OIL AS A COOLANT

Table 3: Evaluation of PV unit through cooling Construction

Edible oil	Decrease in unit temperature for the monocrystalline unit including cooling	Decrease in unit temperature for the polycrystalline unit including cooling	Enhancement in competence for the monocrystalline unit including cooling	Enhancement in competence for the polycrystalline unit including cooling
Peanut oil	2.29%	4.34%	15.0%	17.80%

Table 3signify the evaluation of decreasein unitheat and enhancement in competence for not including and including cooling intended in favour ofthe monocrystalline and polycrystalline unit. Beginning the Table, it is concluded so as to the polycrystalline unithaveenhanced the functioning on unitbeneaththe completecooling intermediate. Designed foreveryone, the polycrystalline unitfunctionimproved than the monocrystalline unit. The monocrystalline and polycrystalline unit functioningbeneath peanut oilsincethe cooling intermediate has createdbetter functioning.

II. CONCLUSION

The work evaluated the possibility of rearexterior cooling of the monocrystalline and polycrystalline unit with means ofwaste edible oil as coolant. At this time, the ecologicalgracious edible is use as an exchangetowards the mineral oil. The function of the unit including and not including coolant is experiential for dissimilar edible oilsimilar to peanut oil. The peanut oils, the competence of the monocrystalline and polycrystalline unit amplifiestowards 15.0% and 17.80%. Beginning the experiential outcome, the workproposesso as to the wasteedible oilbe able to use as coolantexchangetowards the noxious mineral oil or water in container of shortage. Theuse edible oilsincea coolant is a cost reduction, atmospheregracious, whichbe able toincorporatedkeen on the unit to uphold the necessary functioningheat. In opportunity, the build-uptemperature inoilbe able to use for the temperaturesubmissions.

REFERENCE

[1] Hankins H. Stand-alone solar electric systems. London: Earthscan; 2010.
[2] Wong J, Sridharan R, Shanmugam V. Quantifying edge and peripheral recombination losses in industrial silicon solar cells. IEEE Trans Electron Devices 2015;62(11):3750–5. Article No.7289429.
[3] H.M. Ali, M. Mahmood, M.A. Bashir, M. Ali, A.M. Siddiqui, Outdoor testing of photovoltaic modules during summer in Taxila, Pakistan, J. Therm. Sci. (2013).
[4] Reddy, S.R., Ebadian, M.A., Lin, C.-X., 2015. A review of PV–T systems: thermal management and efficiency with single-phase cooling. Int. J. Heat Mass Transf. 91, 861–871.
[5] Koehl, M., Heck, M., Wiesmeier, S., Wirth, J., 2012. Modelling of conditions for accelerated lifetime testing of Humidity impact on PV-modules based on monitoring of climatic data. Sol. Energy Mater. Sol. Cells 99, 282–291.
[6] Zhu L, Raman AP, Fan S. Radiative cooling of solar absorbers using a visibly transparent photonic crystal thermal blackbody. Proc Natl AcadSci 2015;112 (40):12282–7.
[7] Debra H. An investigation on energy performance assessment of a photovoltaic solar wall under buoyancy-induced and fan-assisted ventilation system. Appl Energy 2017; 191: 55–74.
[8] Luque A, Sala G, Arboiro JC. Electric and thermal model for non-uniformly illuminated concentration cells. Sol Energy Mater Sol Cells 1998;51(3– 4):269–90.
[9] Royne A, Dey C, Mills D. Cooling of photovoltaic cells under concentrated illumination: a critical review. Sol Energy Mater Sol Cells 2005;86(4):451– 83.
[10] Cynthia Christabel S, Srinivasan A and Prince Winston D,(2016) "Couple Matching Best Generation Algorithm for Partially Shaded Photovoltaic Systems," Journal of Electrical Engineering, vol. 16, no. 3, pp. 382-391, 2016.
[11] Praveen Kumar B, Prince Winston D, Cynthia Christabel S, et al. (2017), 'Implementation of a Switched PV Technique for Rooftop 2 kW Solar PV to Enhance Power during Unavoidable Partial Shading Conditions' Journal of Power Electronics, 17 (6), 1600-1610. DOI: 10.6113/JPE.2017.17.6.1600.
[12] Prince Winston D, Praveen Kumar B, Cynthia Christabel S (2018) "Maximum power extraction in solar renewable power system - a bypass diode scanning approach," Computers and Electrical Engineering 2018, 70, pp. 122-136.

[13] D. Prince Winston,S.Kumaravel, B. Praveen Kumar, S. Devakirubakaran(2019) "Performance improvement of solar PV array topologies during various partial shading conditions" Solar Energy-Elsevier (196), pp.228–242.
[14] Edenburn MW, Burns JR. Shading analysis of a photovoltaic-cell string illuminated by a parabolic-trough concentrator. NASA STI/Recon Technical Report N, vol. 83; Sep. 1982. p. 21537.
[15] Benemann J, Chehab O, Schaar-Gabriel E. Building-integrated PV modules. Sol Energy Mater Sol Cells 2001;67:345–54.
[16] Bazilian M, Leenders F, Van Der Ree BGC, Prasad D. Photovoltaic cogeneration in the built environment. Sol Energy 2001;71:57–69.
[17] Naphon P. On the performance and entropy generation of the double-pass solar air heater with longitudinal fins. Renew Energy 2005;30:1345–57.
[18] Kolb A, Winter ERF, Viskanta R. Experimental studies on a solar air collector with metal matrix absorber. Sol Energy 1999;65:91–8.
[19] Choudhury C, Garg HP. Performance of air-heating collector with packed airflow passage. Sol Energy 1993;50:205–21.
[20] Krauter S. Increased electrical yield via water flow over the front of photovoltaic panels. Solar Energy Materials & Solar Cells 2004;82:131e7.
[21] Saad O, Masud B. Improving photovoltaic module efficiency using water cooling. Heat Transfer Engineering 2009;30(6):499e505.
[22] Abdolzadeh M, Ameri M. Improving the effectiveness of a PV water pumping system by spraying water over the front of photovoltaic cells. Renewable Energy 2009;34:91e6.
[23] Rosa CM, Rosa CP, Tina GM, Scandura PF. Submerged photovoltaic solar panel: SP2. Renewable Energy 2010;35(8):1862e5.
[24] Prakash, J., 1994. Transient analysis of a photovoltaic/thermal solar collector for co-generation of electricity and hot air/water. Energy Conversion and Management 35, 967–972.
[25] Oommen TV. Vegetable oils for liquid-filled transformers. IEEE ElectrInsul Mag 2002;18 (1):7–11.
[26] F. Qiu, et al., Biodiesel production from mixed soybean oil and rapeseed oil, Appl. Energy 88 (2011) 2050–2055.
[27] Shahidi F, editor. 6th edition Bailey's Industrial oil and fat products, 1–6. Hoboken, New Jersey: Published by John Wiley & Sons, Inc.; 2005.
[28] SabarinathSankaran Nair, KumarapillaiPrabhakaran Nair and Perikinalil Krishnan Rajendrakumar "Evaluation of physicochemical, thermal and tribological
[29] properties of sesame oil (Sesamumindicum L.): a potential agricultural crop base stock for eco-friendly industrial lubricants, Int. J. Agricultural Resources, Governance and Ecology, Vol. 13, No. 1, 2017.

