ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 11, S Iss 1, Nov 2022

STEAM DISTILLATION OF TULASI OIL USING SOLAR CU-PLATE

[1]Sk.Shaheda, [2]V.V.BasavaRao, [3]P.L.C.Saikiran, [4]E. Sunanda, [5]G. Meghana
[1]Assistant Professor, Department Of Chemical Engineering,Anurag University, Venkata Puram, Hyderabad.
[2]Professor, Department of Chemical Engineering, OUCT, OU, Hyderabad.
[3, 4, 5] B.Tech Scholars, Department Of Chemical Engineering,Anurag University, Venkata Puram, Hyderabad.
Address for correspondence: shaheda.chem@anurag.edu.in

ABSTRACT: Essential oils have been commonly used since ancient times. These oils are also largelyused for the preparation of medicines. These essential oils are extracted from various parts of theherbs and medicinal plants such as stems, leaves, roots, seeds etc. Tulasi, Eucalyptus,lavender, lemon grass, rose marry, lavender, and many more types of essential oils that are widelyused in curing of many diseases.In this paper we are extracting Tulasi oilusing differentdistillation methods using renewable energy source i.e., solar energy with a robustly designedCopper clad panel. Bio-active components like Germacrene - D, β - Caryophyllene, Camphene,α-Cubebenearebeingobtained from dried Tulasileavesusingsteamdistillation.Steamdistillation is a conventionalprocessthat is used to effectively get rid of these stipulation oils. Themain concerns in this extraction process are higher efficiency,lower cost and a sustainableenergysource.Hence steam is being produced usingsolar copper cladpanelofdimensions30cmx30cmx2mm.Thiscopper cladplateisdetachedwithferricchlorideandcoatedwith a lead and the circuit with a 2-pole terminal and silicone paste is applied all over the panel as thin layer.This Solar Cu Clad plate is capable of generating power equivalent to fully charged 24 voltsbatteryfor6-10 hrs.

KEYWORDS: EssentialOil,OcimumSanctum,Renewablesource,Solarcoppercladplate,Etching.

I. INTRODUCTION

The utilization of medicinal plants in conventional medication had explained in the literature for the last many 1000 years.Inrecentsupporting and alternate medical execution,herbs are the main source of Therapeutics andeverysegment including the seeds, root,stem,leaves,as well asfruit,capably consist of bioactive elements. There are more beneficial for the utilization of medicinal plants, the major are being their worth it as well as universalaccessibility. Their harmlessness collates with another medicinal outcomes and the deficiency of important side-effects are the remaining benefits.

Fig. 1: TULASI LEAVES

In medicinal plants, aromatic plants are a great source of biological functional elements which are required in agriculture as well as medicine. Among these, Ocimum tenoflorum also called as Tulsi that is explained as the "Queen of plants" because of its conscious medicinal properties.

It is one of the high beneficial and collected plants utilized from the past years in conventional medication in India and each segment of the herb was noticed to have therapeutic characteristics.Conventionalutilizing of Tulasi obtainsin the treatment of fluid as well as various kinds of poisoning, stomach-

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ache, common colds, headaches, malaria, inflammation, and heart disease.

Table 1: PHYSICAL PROPERTIES OF TULASI OIL

Properties	Range
PhysicalState	Liquid
Color	PaleYellowtoDark Yellow
Odour	CharacteristicofBasil,Spicy
SpecificGravity	0.980gm/cc
RefractiveIndex	1.500 – 1.520
Flash Point	176°C
BoilingPoint	54°C
OpticalRotation	-5.99
Solubilityin Water	Insoluble

II. LITERATURE SURVEY

C. A. Calderon et. al. [1] implemented design for automatic balancing of temperature in method in production of necessary oils. These are the most utilized methods to obtain required oils is purified by water-steam drag, but to covenant security inrespect of dutyinjuries, so that synthesize the feature of the obtained oil, there is a required certification for the specified methods to have an computerized temperature regulator , that control the method. As an output of thisactivity, a simulation temperature regulator was developed as well astheir practice was calculated in a test center distiller. In the calculation of the etiquette of the temperature regulator, increase in time (Tr) Exactly 15 minutes, Settling time (Ts) greater than 40 min., and steady state error (Ess) less than 2 °C was acquired.

NurhaniKasuan et. al. [2] simulates the Fuzzy Model Reference Learning Control (FMRLC) depending on Auto Regressive Exogenous modeled herbs to control the method of steam temperature up to 85°C. The Fuzzy model reference learning control was designed to control steam temperature inner side of the distillation column at the time of distillation method. Continuing the temperature of a particular degree for the duration of distillation method is significant due to the temperature that affects the outcome standard as well as amount of necessary oil. The process was depended on tuning process to extract optimized Fuzzy model reference learning control aspects. Then, the simulated output was validated by actual method execution.

Nurul Nadia Mohammad et. al. [3] explains a Fuzzy Logic Controller (FLC) had developed to regulate the steam temperature in distillation for the obtaining the oil. Temperature controller is a significant aspect to ignore decrease in standard oil provided.PRBS (Pseudorandom Binary Sequence) input is activating to the system and result of the steam temperature is designed by utilizing Auto Regressive Moving Average with Exogenous plantsdesign structure. FLC model with two inputs as well as one result fault, variance error and corresponding voltage. There are 49 fuzzy principles that associated in executing the fuzzy logic controller. The observational output exhibits by thefuzzy logic controller reaches the best output in regulating the temperature as differentiatedwith the Proportional Integral Derivative controller by observing theexperiment on the following set point.

Nazurah Tajjudinet. al. [4] implemented self tuning Proportional Integral Derivative (PDI) controller to enhance the steam distillation temperature control. This research is known for distinguishing

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proportional integral production Derivative, Fuzzy Logic as well as self tuning PID controller gives increase in duration, % overshoot and settling duration. The ARX (Auto Regressive Exogenous) method is used to show the effect of the steam distillation process. From the simulation, it is perspicuously demonstrated that self tuning PID controller provides best effect collated with traditional Fuzzy logic and Proportional Integral Derivativecontroller.

Nurhani Kasuan et. al. [5] performs a controlled steam distillation process to obtain necessary oil of Kaffir lime. Temperature of the water in the method was regulated by ON or OFF controller. Execution of the system is calculated depending on oil manufacture cost and estimation on the compositions in Kaffir lime leaves and peels accordingly. The Kaffir lime needed oil an element was noticed by retention duration as well as percentage area by Gas Chromatography - Mass Spectrophotometry (GC-MS). Outputsdisplays the essential oil percentage yield given by modified steam distillation was 1.34% (peels) and 0.43% (leaves) but for hydro distillation yielded 0.16% (peels) and 0.18% (leaves). Depending on mixtures, oil obtained by controlled steam distillation gain is greater than the percentage of limonene (27.97%) as well as pinene (9.82%) compared to hydro distillation

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III. STEAMDISTILLATION

The methods that are available for the distillation of Tulasi oil aresteam and hydro distillation, out of that steam distillation is themost viableoption. Steam Distillation is a process where the plant material is soaked in adesirable solution based on selectivity of an extracting solvent. Throughthis solvent the active bio components are extracted and distillated withsteamatthe boilingtemperature of theknown oil.

By using n-Hexane as the extracting solvent as it as the abilitytoextractmaxcomponentsfromthedried Tulasileavesandhasatemperaturerange favorable fordistillation of Tulasioil.

Fig. 2: STEAM DISTILLATION APPARATUS

Materialsrequired:
Sources: DriedTulasiLeaves (500g)
Chemicals:N-Hexane(Pure-99.99%),Water.
Equipments: SteamDistillationsetup– 3Neckroundbottomflask,Spiralcoolingcondenser,Retortstand and tubes,Grinding Equipment– Ball mill.

Procedure:

1. InthesteamDistillationprocess,firstdry 500 grams offreshgreenTulasileaves(OcimumSanctum/ BasilLeaves) thatareseparated fromsmall branchesand stems.
2. After drying grind the leaves inBall Mill

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for about30 mins with200 rpmsat its critical speed.
3. SeparatetheballsandTulasi leavespowder mechanicallyorusingasieve.
4. Soakthepowderin N-Hexanein a closed containerforaround15-30 mins.
5. The ratio of mixing should be 2: 4 for leaves and n-hexane.
6. Oncetheleavesareperfectlysoakedtransferthe solutionwithsoakedpowderintoa3 neckedroundbottom flask.
7. Place areflux tubeinbetweencondenserandthecenterneckof theroundbottomflaskto collect theproductat thebottom.
8. Connectthecenternecktothespiralcondenser;c losetheotherneckwithacorkandintheneck insertalaboratory thermometertomeasurethe temperaturereadings.
9. Heat the round bottom flask on the electric heater and utilizing an electric heater in the temperature range of 60 to 70^{o}C.
10. Controltheinternal temperatureof theround bottomflaskby changingtheheaterswitch.
11. Thecompleteprocesstakesupto3-4hrsafterthecompletionofdistillationprocess, collectthebottom product and pourdownin the separating funnel.
12. Theseparatingfunnelhastwolayers,asshownin thefigurebelow,theoilandwater whichareimmiscibleinnature.
13. Aftersettlingdownofthe2layersseparatetheoil andcollectassampleforGC&MS(Gas Chromatography & Mass Spectroscopy).

SolarCu-cladpanel:

For Steam generation it need a renewable energy source, at a laboratory level the usage of Renewable Energy Source (RES)is appreciable but at an industry level the solution may be viable and is highly advantageous aspowereconomyand costefficiencyarethemajorconcernsforany technologicalIndustry.

Energy is major to any task in our daily lives. May be forAgricultural,Industrialordomesticpurpose sasofenvironmentalconcerns and availability of fossil fuelsonearthledtothecurrenttrendforutilizatio nofrenewableenergysources.

Consideringthefactthat“Solar”,“Hydro”and“ Wind”renewableenergysourcesaretheformid able technologies with high power generation, Solar energy is an lasting source. Thus,investingourR&D in solar power would be a big step forward.

Usage of solar energy collectors for capturing solar power is a pre dominant technology. Thus, our problem statement focuses on development of new techniques in designing ofsolar energy collectors. Our approach and development in using copper clad plates for energyproductionis an investible technology in the economical way.

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Fig. 3: SOLAR CU-CLAD PLATE SETUP

In the designing part of solar copper clad, firstly a negative and positive terminal is drawn on thecopperboardusingamarkerandit is then coated with ferric chloridesolution.Thecopper coating removed from the surface and terminal marking remains on the clad board can then be cleaned.At this marking lead/tin is coated which acts as the positiveterminal. The surface is coated with silicone paste and connected to a battery using connecting wires asshownin thefigure.

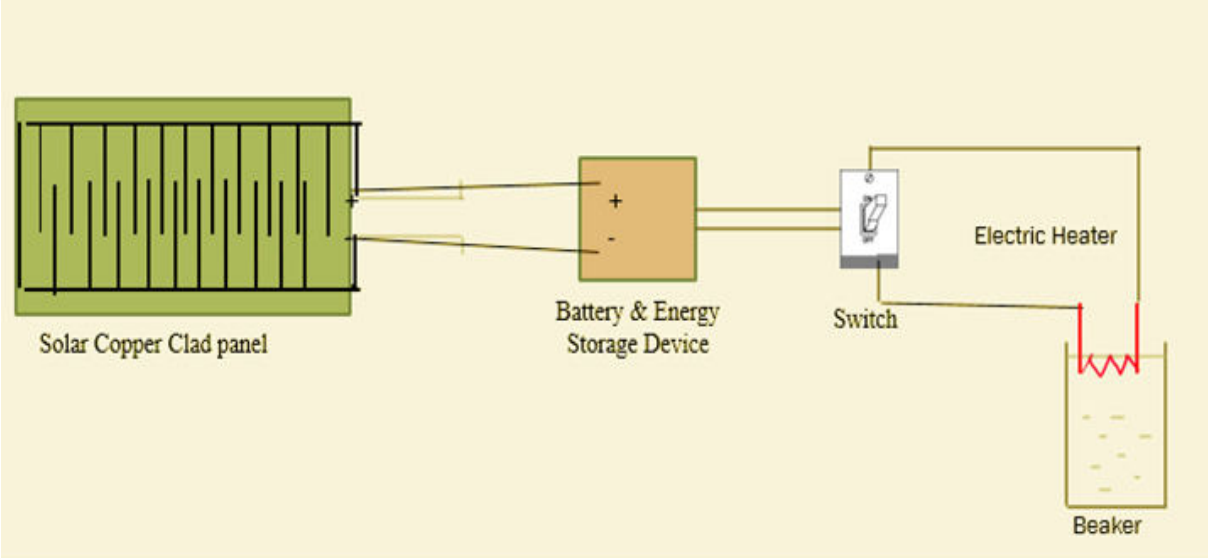

Fig. 4: FLOW DIAGRAM OF SOLAR CU PANNEL SETUP

The power that is stored in the battery is being used for steam generation. The Solar-Cu plate isaffordable and easy making process when compared to the general solar panel. The makingprocessand operation isvery easy and clear. The development of this technology would definitely lead to a larger spectrum of opportunities inrenewableenergy.Thepreparedcrystalsilico nesolarpanelcoppercladabsorbstheincidentso lar radiation, and storage absorbed by their solar energy in an energy storage device. Thisstored energy can then be used forseveral of purposes like heating the water by means of anelectricheater as shown in the figureabove.

IV. RESULT ANALYSIS

The Tin-Crystal Silicone coated copper clads and tried to convert the solar energy

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intoelectricity. Tried it with copper plates of various dimensions and got wide range of reading. On average, onesolar panelcoppercladwas able to produce around 1883 mVof current.

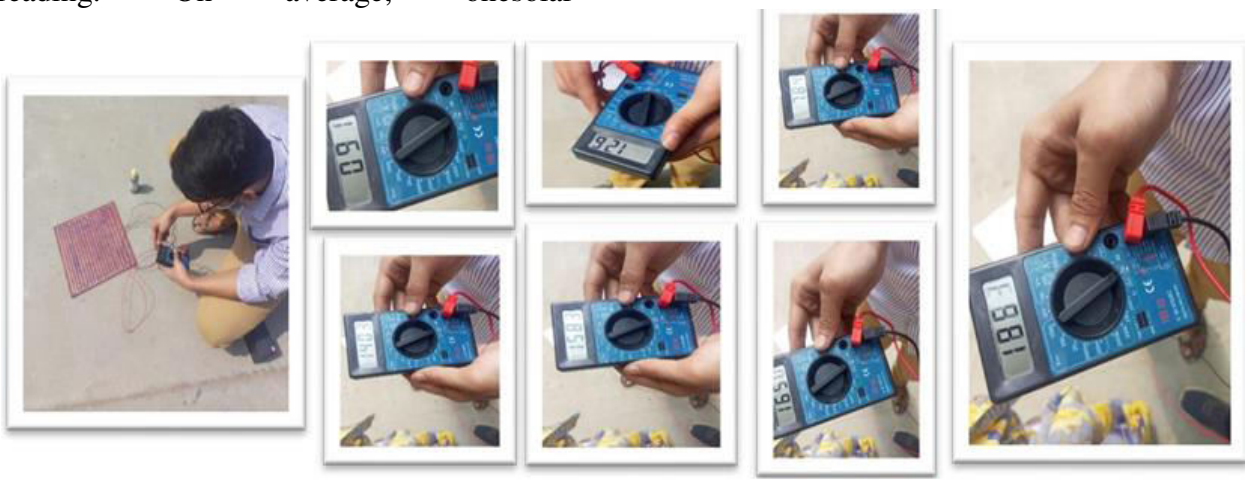

Fig. 5: TESTING OF SOLAR CU CLAD PLATE

Specificationsforsteamgeneration andReport analysis:

Table 2: SOLAR CYCLE REPORT ANALYSIS

S.No	Specification	Requirements
1	CapacityofSolarpanel	200watt
2	Cu-Cladplatedimensions	30cmx 30cmx2mm
3	CapacityofBattery	20Volts
4	Chargingtime	6-10hrs

CostEstimation:

On an average for a simple copper clad of dimensions 30cm*25cm*2mm, the cost required forone solar panel was around Rs. 500/- to Rs.750/- . It is therefore working to increase this method of solar energy to electricity conversion and for thereby bringing down the cost ofproduction.

The cost for scalability, designing, operation, andrecycling is to be studied; therefore furtherdevelopments are to be proceeded. The power is being generated using the solar Cu - CladPlateis used forsteam generation inthedistillation process.

Gas Chromatography - Mass Spectrophotometry (GC-MS) analysisreports:

TOTALIONCHROMATOGRAM(TIC) OFTULSIOIL:

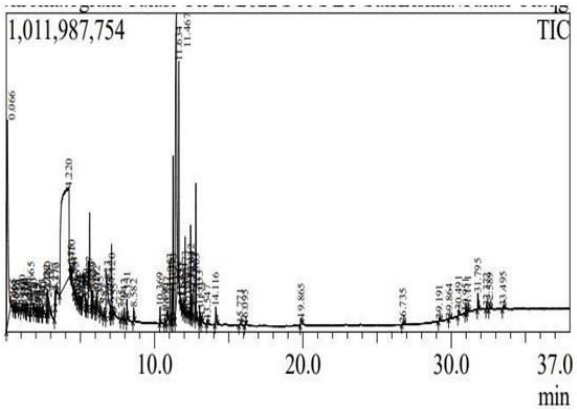

Fig. 6: SAMPLE-1 CHROMATOGRAM

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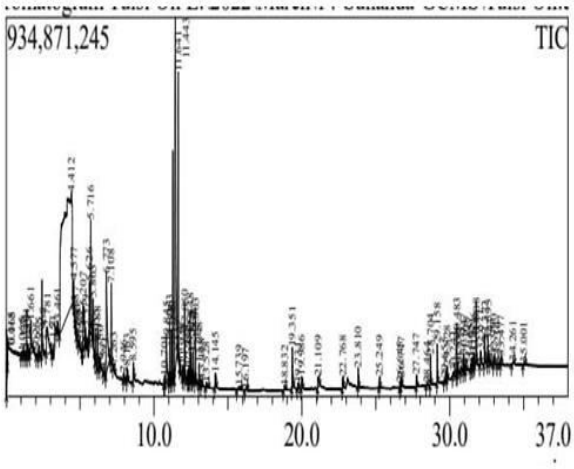

Fig. 7: SAMPLE-2 CHROMATOGRAM

1. The TIC represents the extracted intensity across the entire range of masses being detectedatevery point in theanalysis.
2The graph above shows the x-axis is minutes and the y-axis is distance.

COMPONENTSEXTRACTED:

Table 3: COMPONENTS RETAINED FROM STEAM DISTILLATION

S.no.	COMPONENTS	USES
1	Beta Caryophyllene	1. It is used as antimicrobial, anti-inflammatory, anti-bacterial, anti- oxidant properties. 2. It is well known tosupport relieve anxiety as well as pain, decrease cholesterol avert steoporosis and cure seizures.
2	Camphene	Synthesis sandalwood fragrance. 2. Synthetic perfumes, in synthetic camphor and as a food additive for flavoring purpose.
3	Germacrene-D	Used in fragrances & flavoring of wood
4	AlphaCubebene	1. Natural Metabolite used in vitamins and supplements 2. Used as a natural fragrance.
5	Rosmarinic acid	1.It helps in treating inflammatory conditions like arthritis, asthma 2.And prevents the proliferation ofhuman cancer cells. 3. It is a naturally found antioxidant in many herbs such as lemon balm, oregano, peppermint.

There are many other components that have been extracted from the oil in the steam distillationprocess.The abovelisteddesiredcomponentshavebeenmaintainedinmaxcompositions.

V. CONCLUSION

In this paper, steam distillation of Tulasi oil using solar copper plate is described. Steamdistillation is a conventional process that is utilized for effectively obtaining these

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essential oils. Steamisbeinggeneratedusingsolarcopperclad panelofdimensions30cmx30cmx2mm.Thiscopppercladplateisetchedwithferricchlorideandcoatedwithleadas a circuit with a 2-pole terminal and silicone paste is applied all over the panel as thin layer.Tin-Crystal Silicone coated copper clads and tried to convert the solar energy intoelectricity. Gas Chromatography - Mass Spectrophotometry (GC-MS) reports are analyzed in the results section. Several components have been extracted from the oil in the steam distillationprocess.

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