RVS COLLEGE OF ENGINEERING AND TECHNOLOGY

Kumaran Kottam Campus, Kannampalayam (Po),Coimbatore – 641 402
(Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai)
NAAC Accredited and ISO 21001:2018 certified Institution

Name of the Course that include experiential learning through project work/field work/internship:

External work of evaporation; Internal energy; Entropy of vapour, Expansion of vapour, Rankine cycle. Steam turbines – Impulse and Reaction types - Principles of operation.

UNIT V SIMPLE MECHANISM, FLY WHEEL, DRIVES AND BALNCING 12

Definition of Kinematic Links, Pairs and Kinematic Chains; Flywheel-Turning moment Diagram; Fluctuation of Energy. Belt and rope drives; Velocity ratio; slip; Creep; Ratio of tensions; Length of belt; Power Transmitted; gear trains-types. Balancing of rotating masses in same plane; Balancing of masses rotating in different planes.

TOTAL : 60 PERIODS

OUTCOME

- Students should learn thermodynamics and thermal engineering to understand the principles behind the operation of thermal equipments like IC engines and turbines etc., Students should be able to appreciate the theory behind operation of machinery and be able to design simple mechanisms

TEXT BOOKS

1. Nag, P.K., "Engineering Thermodynamics ", IInd Edition, Tata McGraw Hill Publishing Co., Ltd., 1995
2. Rajput, R .K, "Thermal Engineering", Laxmi publications (P) Ltd, 2001.
3. Khurmi R.S., and Gupta J.K, "Theory of Machines", Eurasia Publishing House (P) Ltd., 2004.

REFERENCES

1. Bhaskaran, K.A., and Venkatesh, A., "Engineering Thermodynamics ",Tata McGraw Hill, 1973.
2. Khurmi R.S., and Gupta J.K, "Thermal Engineering", S.Chand & Company (P) Ltd.,2001.
3. Kothandaraman and Dhomkundwar,": A course in Thermal Engineering (SI Units)", Dhanpat Rai and Sons, Delhi (2001)
4. Pandya A. and Shah, " Theory of Machines ", Charatakar Publishers, 1975.
5. Smith, "Chemical Thermodynamics ", Reinhold Publishing Co., 1977.

PM8251	**INDUSTRIAL CHEMICAL TECHNOLOGY**	**L T P C**
		3 0 0 3

OBJECTIVE:

- To enable the students to gain knowledge on various aspects of production engineering and understand the practical methods of production in a chemical factory.

UNIT I SULFUR, SULFURIC ACID AND CEMENT 9

Sulfur, Raw materials Sources, Mining and production of Sulfur – Sulfuric acid, Methods of production of Sulfuric acid – Contact process – Chamber process. Cement – properties of Cement – Methods of production – Overall factors for Cement industry.

UNIT II FERTILIZER INDUSTRY, FUEL AND INDUSTRIAL GASES 9

Major Components of Fertilizer industries – Nitrogen industries, ammonia, nitric acid, urea – Phosphorus industries - Phosphorus, Phosphoric acid, Super Phosphate – Potassium chloride, Potassium Sulphate – Fuel Gases – Producer gas, Water gas, Coke oven gas, Natural gas, Liquefied natural gas – Industrial gases – Carbon dioxide, hydrogen, nitrogen and oxygen. .

UNIT III PULP, PAPER, SUGAR AND STARCH INDUSTRIES 9

Pulp – Methods of production – Comparison of pulping processes. Paper – types of paper products, Raw materials, Methods of production. Sugar – Methods of production – by products of the Sugar industry – Starch – Methods of production, Starch derivations. .

UNIT IV PETROLEUM AND PETRO CHEMICAL INDUSTRIES 9

Petroleum – Chemical Composition, Classification of crude petroleum, Petroleum Refinery products – Petroleum Conversion processes – Pyrolysis and Cracking, Reforming Polymerization, isomerization and Alkylation – petrochemicals – methanol, chloro methanol, Acetylene and ethylene, Isopropanol, Acrylonitrile, Buta diane – Chemicals from Aromatics - Benzene, Toluene and Xylene.

U**NIT V RUBBERS, POLYMERS AND SYNTHETIC FIBRE 9**

Natural and Synthetic rubber, SBR – Silicone rubber – polymer – physical – chemical structure of polymers, Thermosetting and Thermoplastic materials - Polymer manufacturing processes – polyethylene, polystyrene – Resins phenolic and epoxy resins – Synthetic Fibers – Viscose rayon, Polyamides and polyesters.

TOTAL : 45 PERIODS

OUTCOME:

- Student can classify the chemical process industry into industrial categories of base, intermediate end-products and specialty chemicals manufacturers.

TEXT BOOKS:

1. Dryden, C.E, Outlines of Chemical technology, II Ed., Affiliate East West press, 2003.
2. Moulin, J.A., M. Makkee, and Diepen, A.V., Chemical Process Technology, Wiley, 2001.

REFERENCES:

1. Austin, G.T., Shreve's "Chemical Process Industries", 5th ed., McGraw-Hill, 1998.
2. Srikumar Koyikkal,"Chemical Process Technology and Simulation",PHI Learning Ltd (2013).

CY8281 ORGANIC CHEMISTRY LABORATORY L T P C
0 0 4 2

OBJECTIVE:

- To learn basic principles involved in analysis and synthesis of different organic derivatives.

LIST OF EXPERIMENTS

1. Quantitative analysis of organic compounds – Identification of aliphatic/aromatic, saturated/unsaturated compounds.
2. Identification and characterization of various functional groups by their characteristic reactions:
   a) alcohol, b) aldehyde, c) ketone, d) carboxylic acid, e) phenol, f) ester,
   g) primary, secondary and tertiary amines and h) nitro compounds.
3. Analysis of an unknown organic compound and preparation of suitable solid derivatives (Benzoic acid from Benzaldhehyde, hydrolysis of ester and meta- dinitrobenzene from nitrobenzene) .
4. Analysis of carbohydrates.
5. Analysis of proteins.
6. Methodology of filtration and recrystallization.

MAKING GREASE FROM USED ENGINE OIL

A PROJECT REPORT

Submitted by

HARIPRASATH R 712819139501

PRAVEEN KUMAR R 712819139502

in partial fulfilment for the award of the degree

of

BACHELOR OF ENGINEERING

in

PETRO CHEMICAL ENGINEERING

RVS COLLEGE OF ENGINEERING AND TECHNOLOGY

COIMBATORE-641402

ANNA UNIVERSITY: CHENNAI 600 025

MAY 2023

ANNA UNIVERSITY: CHENNAI 600 025

BONAFIDE CERTIFICATE

Certified that this project report **"MAKING GREASE FROM WASTE ENGINE OIL"** is the bonafide work of **HARIPRASATH R, PRAVEEN KUMAR R** who carried out the project work under my supervision

SIGNATURE	**SIGNATURE**
Dr. R. Kannan., M.Tech., P.hd.,	**Dr. B. Vijaya Kumar., M.Tech., P.hd.,**
PROFESSOR AND HEAD	**ASSOCIATE PROFESSOR**
	SUPERVISOR
Department of Petrochemical	Department of Petrochemical
RVS College of Engineering and	RVS College of Engineering and
Technology, Coimbatore-641 402	Technology, Coimbatore-641 402

Submitted for the project Viva-Voice examination held on 22.05.2023

22/05/23	22/05/23
INTERNAL EXAMINER	EXTERNAL EXAMINER

ABSTRACT

Grease from the early Egyptian or Roman eras is thought to have been prepared by combine lime with olive oil.

The lime saponifies some of the triglyceride that comprises oil to give calcium grease. In the middle of the 19th

century, soaps were intentionally added as thickeners to oils. Over the centuries, all manner of material has been

employed as greases, for example black slugs Arionater were used as axle grease to lubricate wooden axel trees or

cars in Sweden.

Keywords –Additives, Apparent Viscosity, Consistency, Grease, Lubrication, Oil, Temperature, Saponify. Petroleum-derived products, such as lubricant oils, are non-renewable resources that, after use, must be collected and processed properly to avoid negative environmental impacts. A circular economy of used oils requires the re-refining and reuse of the same. Similar to most countries in Latin America, the management of used oils in Ecuador is still incipient and few cities collect and treat this material properly. In Cuenca, the ETAPA company collects ~1344 t/year of used oils, which are subjected to pretreatment operations prior to their use as fuel in a cement factory. However, combustion generates polluting gases and disallows the adding of value to the used oils. The lack of studies on the characterization and methods utilized for recovering used oils under the conditions found in medium-size Latin-American cities (e.g., Cuenca), alongside a lack of government policies, have hindered the adoption of re-refining operations. The objective of this work is to characterize the used lubricant oils in Cuenca, to compare them with the properties of used oils from other countries, and to suggest some re-refining technologies for oils with similar properties. Used oil samples were collected from mechanic shops and car-lubricating shops for characterization. Its physicochemical properties and metal contents are comparable to the used oils in other countries globally

Specifically, the flash point, kinematic viscosity, TBN, and concentrations of Zn, Cd, and Mg are similar to the properties of used oils in Iraq, Egypt, and the United Arab Emirates. Based on these results, the best re-refining option for used oils in Cuenca is extraction with solvents in which sedimentation and dehydration (already conducted in Cuenca) is followed by a solvent reaction process, a vacuum distillation process, a finishing process with bentonite, and a final filtration step.

TEXT BOOKS:

1. V.Raghavan, "Materials Science and Engineering: A first course", V Edition, Prentice Hall of India , 2004.
2. Van Vlack L.H , "Elements of Materials Science and Engineering" (Addision Wesley series in metallurgy and materials engineering), VI Edition, Prentice Hall, 6th Edition, 1989.

REFERENCES:

1. WF.Hosford, "Material Science", Cambridge Univ. Press, New York, 2006.
2. C.Srinivasan, " Science of Engineering Materials", John Wiley, New York, 1987.

CH8351	PROCESS CALCULATIONS	L T P C
		3 2 0 4

OBJECTIVE:

- To acquire knowledge on laws of chemistry and its application to solution of mass and energy balance equations for single and network of units and introduce to process simulators.

UNIT I **15**

Base and derived Units - Composition of Mixture and solutions - calculations of pressure, volume and temperature using ideal gas law. Use of partial pressure and pure component volume in gas calculations, applications of real gas relationship in gas calculation.

UNIT II **15**

Stoichiometric principles, Application of material balance to unit operations like distillation, evaporation, crystallisation, drying etc., - Material balance with chemical reaction - Limiting and excess reactants - recycle - bypass and purging - Unsteady state material balances.

UNIT III **15**

Calculation of absolute humidity, molal humidity, relative humidity and percentage humidity - Use of humidity in condensation and drying - Humidity chart, dew point.

UNITIV **15**

Heat capacity of solids, liquids, gases and solutions, use of mean heat capacity in heat calculations, problems involving sensible heat and latent heats, evaluation of enthalpy.Standard heat of reaction, heats of formation, combustion, solution, mixing etc., calculation of standard heat of reaction - Effect of pressure and temperature on heat of reaction -Energy balance for systems with and without chemical reaction - Unsteady state energy balances

UNIT V **15**

Determination of Composition by Orsat analysis of products of combustion of solid, liquid and gas fuels - Calculation of excess air from orsat technique, problems on sulphur and sulphur burning compounds - Application of Process simulators in energy and material balance problems.

TOTAL: 75 PERIODS

OUTCOMES:

- Understand the fundamentals of units and stoichiometric equations.
- Write material balance for different chemical process.
- Understand the fundamentals of ideal gas behavior and phase equilbria. Write energy balance for different chemical process.

PRODUCTION OF BIODIESEL FROM WASTE COOKING OIL USING NANO CATALYST ($MgO/Fe_3O_4/Cs_2O$)

A PROJECT REPORT

Submitted by

GUNASEKAR K	712819139008
NOUFAL N	712819139016
ASHIK JIJI	712819139704
SARATH KUMAR T S	712819139706

In partial fulfilment of award of the degree

Of

BACHELOR OF ENGINEERING

In

PETROCHEMICAL ENGINEERING

PROGRESS THROUGH KNOWLEDGE

RVS COLLEGE OF ENGINEERING AND TECHNOLOGY, COIMBATORE

ANNA UNIVERSIY CHENNAI 600025

MAY 2023

ANNA UNIVERSITY: CHENNAI 600 025

BONAFIDE CERTIFICATE

Certified that this project report "PRODUCTION OF BIODIESEL FROM WASTE COOKING OIL USING NANO CATALYST ($MgO/Fe_3O_4/Cs_2O$)" is the bonafide work of "GUNASEKAR K, NOUFAL N, ASHIK JIJI, SARATH KUMAR T S" who carried out the project work under my supervision.

SIGNATURE	SIGNATURE
Dr. R. KANNAN., MTech., Ph.D.	**Dr. B. VIJAYA KUMAR., M. Tech., Ph.D.,**
PROFESSOR,	SUPERVISOR,
HEAD OF THE DEPARTMENT,	ASSOCIATE PROFESSOR,
Department of Petrochemical Engineering,	Department of Petrochemical Engineering,
RVS College of Engineering &Technology,	RVS College of Engineering &Technology,
Coimbatore-641 402	Coimbatore-641 402

Submitted for project viva voice held on 22-5-2023

INTERNAL EXAMINER　　　　EXTERNAL EXAMINER

ABSTRACT

Biodiesel, which is produced through transesterification from a cost-effective feedstock (waste cooking oil) using a Nano catalyst and a short chain alcohol. The Nano catalyst ($MgO/Fe_3O_4/Cs_2O$) was synthesized via co-precipitation method and its characterization is examined for identifying the morphological behaviour through various analytical methods such as SEM, XRD, and FTIR. The activity of the catalyst was identified through transesterification reaction. The biodiesel yield increase with increase in catalyst concentration in the given methanol to oil ratio. The optimal biodiesel yield of 97% was achieved at optimized reaction conditions i.e., WCO to methanol molar ratio of 18:1, 6 wt. % of $MgO/Fe_3O_4/Cs_2O$ nano-catalyst, 50°C reaction temperature and 90 minutes reaction time. The effect of temperature is that at high temperature the reaction is faster and the maximum yield is achieved at 60°C. Further increase in temperature leads to slight decrease in yield of biodiesel because some portion of methanol is in vapour phase. A maximum methyl ester yield of 97% was reached at the molar methanol to oil molar ratio of 18:1. Further increase in methanol did not promote the reaction owing to formation of methanol cloud on the liquid surface by high sonic energy. The produced biodiesel is characterized to match with the ASTM fuel standard.

Key words: Biodiesel, Waste cooking oil, Transesterification, Co-precipitation

LIST OF EXPERIMENTS

1. Port timing diagram
2. Valve timing diagram
3. Study of 2,4 stroke I C Engines
4. Load test on 4-stroke petrol engine
5. Performance test on 4-stroke single cylinder diesel engine
6. Performance test on 4-stroke twin cylinder diesel engine
7. Heat balance test on diesel engines
8. Tension test
9. Compression test
10. Deflection test
11. Hardness test (Rockwell and Brinell)
12. Spring test
13. Torsion test
14. Impact test

TOTAL: 60 PERIODS

* Minimum 10 experiments shall be offered.

OUTCOME

- Students will be able to understand Power-generating units such as engines and operate IC engines and conduct tests. They will be able to appreciate the theory behind the functioning of engines. Material properties, their behavior under different kinds of loading and testing can be visualized.

S. No.	NAME OF THE EQUIPMENT	Qty.
1.	I.C Engine – 2 stroke and 4 stroke model	1 set
2.	4-stroke Diesel Engine with mechanical loading.	1 No.
3.	Torsion cylinder Diesel Engine	1 No.
4.	Universal Tensile Testing machine with double 1 shear attachment –	1
5.	Torsion Testing Machine (60 NM Capacity)	1
6.	Impact Testing Machine (300 J Capacity)	1
7.	Brinell Hardness Testing Machine	1
8.	Rockwell Hardness Testing Machine	1
9.	Spring Testing Machine for tensile and compressive loads (2500 N)	1

PE8491 CHEMICAL ENGINEERING THERMODYNAMICS L T P C
3 0 0 3

OBJECTIVE:

- Students will learn PVT behaviour of fluids, laws of thermodynamics, thermodynamic property relations and their application to fluid flow, power generation and refrigeration processes.

UNIT I **9**

Scope of thermodynamics, basic concepts and definitions, Equilibrium state and phase rule, Energy, Work, Temperature and Zeroth Law of Thermodynamics, reversible and irreversible process, Ideal gas- Equation of State involving ideal and real gas, Law of corresponding states, Compressibility chart, First Law of Thermodynamics and its consequences.

UNIT II **9**

Joule's experiment, internal energy, enthalpy, Application of first Law of Thermodynamics for Flow and non flow processes. Limitations of the first Law , statements of second Law of Thermodynamics and its Applications ,Heat Engine, Heat Pump/Refrigerator, Carnot cycle and Carnot theorem, Thermodynamic Temperature scale, Entropy , Clausius inequality, Third law of thermodynamics.

UNIT III **9**

Refrigeration and liquefaction process, Thermodynamic Potentials, thermodynamic correlation, Maxwell relations, criteria for Equilibria and stability. Clapeyron equation

UNIT IV **9**

Partial molar properties, ideal and non-ideal solutions, standard states definition and choice, Gibbs-Duhem equation, activity and property change of mixing, excess properties of mixtures.

UNIT V **9**

Activity coefficient-composition models, thermodynamic consistency of phase equilibria, ChemicalReaction equilibria, Extent of reaction, equilibrium constant and standard free energy change

TOTAL: 45 PERIODS

OUTCOME:

- The course will help the students to know about engineering thermodynamics and understand the practical implications of thermodynamic law in engineering design.

TEXT BOOKS:

1. Sonntag, Borgnakke, Van Wylen, Fundamentals of Thermodynamics, 7th Edition, Wiley India, New Delhi, 2009.
2. Narayanan, K.V. A Textbook of Chemical Engineering Thermodynamics Prentice Hall India, 2004
3. Smith, van Ness and Abbott, "Chemical Engineering Thermodynamics", 7th Edition, McGraw Hill, New York, 2005

REFERENCES:

1. S. I. Sandler, Chemical, Biochemical and Engineering Thermodynamics, Wiley New York, 2006
2. Y V C Rao, "Chemical Engineering Thermodynamics", Universities Press, Hyderabad 2005.
3. Pradeep ahuja," Chemical Engineering Thermodynamics", PHI Learning Ltd (2009).
4. GopinathHalder," Introduction to Chemical Engineering Thermodynamics", PHI Learning Ltd (2009).

DESIGN COMPARISON OF ETHYLENE GLYCOL AND TRI ETHYLENE GLYCOL DEHYDRATION

A Project Report

Submitted by

Micheal Sajin J	**712819139010**
Mohamed Aashik H	**712819139011**
Vignesh R	**712819139029**
Sathik Ahamed S	**712819139702**

BACHELOR OF ENGINEERING

IN

PETROCHEMICAL ENGINEERING

RVS COLLEGE OF ENGINEERING AND TECHNOLOGY

COIMBATORE-641402

ANNA UNIVERSITY: CHENNAI 600 025

MAY 2023

ANNA UNIVERSITY: CHENNAI 600 025

BONAFIDE CERTIFICATE

Certified that this project report **"DESIGN COMPARISON OF ETHYLENE GLYCOL AND TRI ETHYLENE GLYCOL DEHYDRATION"** is the bonafide work of **"MICHEAL SAJIN J, MOHAMED AASHIK H, VIGNESH R, SATHIK AHAMED S"** who carried out the project work under my supervision.

Dr. R. Kannan

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Dr. R. Kannan

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Dr. R. Kannan

SUPERVISOR

Department of Petrochemical RVS

RVS College of Engineering and

Technology, Coimbatore-641 402

Submitted for the project Viva-Voice examination held on 22.05.2023

22/5/23

INTERNAL EXAMINER

EXTERNAL EXAMINER

ABSTRACT

Glycol dehydration is a widely used method for the removal of water from natural gas, using glycol as a solvent to absorb water from the gas stream. The presence of water will promote the occurrence of corrosion and hydrate formation along the gas pipelines. Tri-Ethylene Glycol (TEG) is commonly used as the solvent for glycol dehydration. The main environmental concern of this TEG process is the emission of benzene, toluene, ethylbenzene, and xylene (BTEX) compounds to the atmosphere.

This study will be using Mono-Ethylene Glycol (MEG) as the solvent, where the objectives are to compare the performance of MEG with TEG, mainly in reducing the amount of BTEX emissions. The scopes of this study are the simulation of three glycol dehydration technologies which are basic, Stahl, and Drizo. MEG will be used as the dehydrating agent in this study, and optimization of operating conditions is done in order to have an optimized process operation of MEG.

The data and results are obtained by process modeling using the Aspen Hysys simulation package. Performance of MEG is evaluated and compared with TEG. Based on our analysis we can see that the usage of MEG significantly reduced the amount of BTEX emissions without any need of equipment addition for the same glycol dehydration technology, where the amount of emission is almost zero. However, usage of MEG will result in higher amount of glycol losses. If MEG is used, it must be determined if the cost of glycol replacement is less than the cost of treating the BTEX emissions.

REFERENCE:

2. Standard Handbook of Petroleum and Natural Gas Engineering. 2nd Edition. William C Lyons, Gary C Plisga. Gulf Professional Publishing.

CH8451 MECHANICAL OPERATIONS L T P C
3 0 0 3

OBJECTIVE:

- To impact knowledge in the field of particle size reduction and also deals with the detail construction and working of equipment's used for mechanical operations.

UNIT I PARTICLE CHARACTERIZATION AND MEASUREMENT 9

General characteristics of solids, different techniques of size analysis- Static - Image analysis and Dynamic analysis - Light scattering techniques, shape factor, surface area determination, estimation of particle size. Advanced particle size analysis techniques. Screening methods and equipment, screen efficiency, ideal and actual screens.

UNIT II PARTICLE SIZE REDUCTION AND SIZE ENLARGEMENT 9

Laws of size reduction, energy relationships in size reduction, methods of size reduction, classification of equipments, crushers, grinders, disintegrators for coarse, intermediate and fine grinding, power requirement, work index; Advanced size reduction techniques - Nano particle fabrication - Top down approach - Bottom-up approach. Size enlargement - Importance of size enlargement, principle of granulation, briquetting, pelletisation, and flocculation. Fundamentals of particle generation.

UNIT III PARTICLE SEPARATION (GAS-SOLID AND LIQUID-SOLID SYSTEM) 9

Gravity settling, sedimentation, thickening, elutriation, double cone classifier, rake classifier, bowl classifier. Centrifugal separation - continuous centrifuges, super centrifuges, design of basket centrifuges; industrial dust removing equipment, cyclones and hydro cyclones, electrostatic and magnetic separators, heavy media separations, floatation, jigging

UNIT IV FILTRATION AND FILTRATION EQUIPMENTS 9

Theory of filtration, Batch and continuous filters, Flow through filter cake and filter media, compressible and incompressible filter cakes, filtration equipments - selection, operation and design of filters and optimum cycle of operation, filter aids.

UNIT V MIXING AND PARTICLE HANDLING 9

Mixing and agitation - Mixing of liquids (with or without solids), mixing of powders, selection of suitable mixers, power requirement for mixing. Storage and Conveying of solids - Bunkers, silos, bins and hoppers, transportation of solids in bulk, Powder hazards, conveyer selection, different types of conveyers and their performance characteristics.

TOTAL: 45 PERIODS

OUTCOME:

- At the end of this course, the students will be able to understand the overview of equipment used to perform various mechanical operations and problems associated during the implementation and applications.

TEXT BOOKS:

1. McCabe, W.L., Smith, J.C., and Harriot, P., "Unit Operations in Chemical Engineering", 7th Edn., McGraw-Hill, 2005.

INVESTIGATING THE IMPACT OF FUEL ADITIVES ON SPARK-IGNITED PETROL INTERNAL COMBUSTION ENGINES

A PROJECT REPORT

Submitted by

GEORGE G SAM	**712819139007**
ANANDU P	**712819139004**
ADWAITH ANIL K	**712819139703**
SURYA PRASAD E P	**712819139026**

In partial fulfilment of award of the degree

Of

BACHELOR OF ENGINEERING

In

PETROCHEMICAL ENGINEERING

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ANNA UNIVERSITY 600025

MAY 2023

ANNA UNIVERSITY: CHENNAI 600 025

BONAFIDE CERTIFICATE

Certified that this project report **"INVESTIGATING THE IMPACT OF FUEL ADITIVES ON SPARK-IGNITED PETROL INTERNAL COMBUSTION ENGINES"** is the bonafide work of **"GEORGE G SAM, ANANDU P, ADWAITH ANIL K, SURYA PRASAD E P"** who carried out the project work under my supervision.

SIGNATURE	**SIGNATURE** 22/5/23
Dr. R. KANNAN., MTech., Ph.D.	**Dr. A SAKTHISARAVANAN., M. Tech., Ph.D.,**
HEAD OF THE DEPARTMENT,	SUPERVISOR,
	ASSISTANT PROFESSOR,
DEPARTMNET OF PETROCHMEICAL ENGINEERING,	DEPARTMNET OF PETROCHMEICAL ENGINEERING,
RVS College of Engineering &Technology,	RVS College of Engineering &Technology,
Coimbatore -641 402	Coimbatore-641 402

Submitted for project viva voce held on 22-05-2023

22/5/23

INTERNAL EXAMINER

EXTERNAL EXAMINER

ABSTRACT

Fuel additives have widespread global use and serve various purposes such as enhancing fuel efficiency, reducing emissions, minimizing the likelihood of knocking, and modifying storage and handling characteristics. Given the significant contribution of internal combustion engines to overall fossil fuel consumption worldwide, fuel additives that enhance the efficiency of these engines can have a substantial impact on global fossil fuel usage and greenhouse gas emissions. In this particular study, the influence of different fuel additive on spark-ignited petrol internal combustion engines was investigated. The main focus of the research was to explore the potential of fuel additives in extending the lean limit, decreasing the propensity for knocking, and increasing power. The experiments were conducted using a single-cylinder internal combustion engine with adjustable compression ratio, capable of running on both gaseous and liquid fuels. The liquid fuel system used a naturally aspirated carburetor. Cylinder pressure data were collected using a high-speed piezoelectric pressure transducer, enabling the calculation of indicated power, peak pressure, and quantification of engine knock. The study specifically examined petrol additives, aiming to determine whether they could enhance engine power, reduce knocking (indicated by an increase in the octane number), or extend the lean limit. This study investigated the possibilities of enhancing the quality of the petrol so that the consumption and the carbon emission caused by the combustion of petrol can be stabilized Most of the fuel efficiency enhancers are manufactured by blending chemicals/petrochemicals or by refining the existing fuel to enhance the octane level and for better combustion by adding alcohol. This study investigated the possibilities of enhancing the quality of the petrol so that the consumption and the carbon emission caused by the combustion of petrol can be stabilized Most of

the fuel efficiency enhancers are manufactured by blending chemicals/petrochemicals or by refining the existing fuel to enhance the octane level and for better combustion by adding alcohol.The results indicated that the additives improved engine efficiency and decreased the likelihood of knocking.

6. Reduction ratio in Ball mill
7. Separation characteristics of Cyclone separator
8. Reduction ratio of Roll Crusher
9. Drop weight crusher
10. Drag on Sphere
11. Effectiveness of screen

EQUIPMENT REQUIRED

1. Sieve shaker
2. Leaf filter
3. Plate and Frame Filter Press
4. Sedimentation Jar
5. Jaw Crusher
6. Ball Mill
7. Cyclone Separator
8. Roll Crusher
9. Elutriator
10. Drop Weight Crusher
11. Sieves.

TOTAL: 60 PERIODS

OUTCOMES:

- Use variable area flow meters and variable head flow meters
- Analyze the flow of fluids through closed conduits, open channels and flow past immersed bodies Select pumps for the transportation of fluids based on process conditions/requirements and fluid properties.
- Determine work index, average particle size through experiments by crushers, ball mill and conducting sieve analysis.
- Design size separation equipments such as cyclone separator, sedimentation, Filters etc.

CH8281	CHEMICAL ANALYSIS LABORATORY	L T P C
	(Minimum of 8 experiments to be conducted)	0 0 4 2

OBJECTIVE:

- To make the student acquire practical skills in the wet chemical and \ instrumental methods for quantitative estimation of nitrite in water, cement, oil, coal and Phenol.

LIST OF EXPERIMENTS

1. Determination of Redwood / Saybolt numbers, kinematic viscosity and viscosity index of Lubricating oils
2. Determination of flash point, fire point, cloud and pour point of oils
3. Determination of acid value and iodine value of oils
4. Determination of COD of water samples
5. Cement Analysis a. Estimation of silica content b. Estimation of mixed oxide content c. Estimation of calcium oxide content d. Estimation of calcium oxide by rapid method
6. Coal Analysis a. Estimation of sulphur present in coal b. Ultimate analysis of coal c. Proximate analysis of coal
7. Soap Analysis a. Estimation of total fatty acid b. Estimation of percentage alkali content
8. Flue gas analysis by Orsat’s apparatus
9. Estimation of phenol.

10. Determination of calorific value using bomb calorimeter
11. Determination of nitrite in water.

S. No.	Description of Equipment	Quantity required
1	Silica Crucible	20
2	Heating Mantle	3
3	Muffle Furnace	1
4	Hot air oven	1
5	Desiccator	5
6	Vacuum Pump	1
7	Condenser	10
8	Reflux Condenser	10
9	Pensky martens closed cup apparatus	1
10	Cleveland Open cup apparatus	1
11	Cloud point apparatus	1
12	Saybolt Viscometer	1
13	Redwood Viscometer	1
14	Bomb Calorimeter	1
15	COD reflux	1
16	Orsat apparatus	1
17	UV-Vis Spectrophotometer	1

TOTAL: 60 PERIODS

OUTCOMES:

- Familiarization with equipment like viscometers, flash and fire point apparatus etc
- Familiarization of methods for determining COD
- Familiarization of a few simple synthetic techniques for soap

REFERENCES:

1. Environmental pollution analysis, S.M.Khopkar, New age international. 2011
2. Manual of environmental analysis, N.C Aery, Ane books. 2010
3. Text book of quantitative chemical analysis, J.Mendham, Pearson education 2008

CH8591 HEAT TRANSFER L T P C
3 2 0 4

OBJECTIVE:

- To enable the students to learn heat transfer by conduction, convection and radiation and heat transfer equipments like evaporator and heat exchanger

UNIT I 15

Importance of heat transfer in Chemical Engineering operations - Modes of heat transfer -

TEXTILE WASTE SLUDGE REUSING FOR FLY ASH BRICK MANUFACTURING

A Project Report

Submitted by

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In partial fulfillment for the award of the degree

of

BACHELOR OF ENGINEERING

in

PETROCHEMICAL ENGINEERING

RVS COLLEGE OF ENGINEERING AND TECHNOLOGY

COIMBATORE-641402

ANNA UNIVERSITY: CHENNAI 600 025

MAY 2023

ANNA UNIVERSITY: CHENNAI 600 025

BONAFIDE CERTIFICATE

Certified that this project report **"TEXTILE WASTE SLUDGE REUSING FOR FLYASH BRICK MANUFATURING"** is the Bonafide work of **"MOULISWARAN R, PRAVEEN KUMAR P, VASANTH S, MOHAMMED RASUL S"** who carried out the project work under my supervision.

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PROFESSOR AND HEAD	**SUPERVISOR**
Department of Petrochemical RVS College of Engineering and Technology, Coimbatore-641 402	Department of Petrochemical RVS College of Engineering and Technology, Coimbatore-641 402

Submitted for the project Viva-Voice examination held on 22-05-2023

INTERNAL EXAMINER **EXTERNAL EXAMINER**

ABSTRACT

The fundamental purpose of this study was to evaluate the technical feasibility of incorporating fly ash (FA) and dyeing sludge (DS) in the production of brick. An attempt was taken to replace 10% to 100% clay by DS and FA in brick-making by volume. A brick firing kiln was used to burn the uniform-shaped bricks after replacing clay with Dyeing Sludge and Fly Ash. Size and shape, hardness, soundness, water absorption, efflorescence, dry density, loss of ignition, firing shrinkage, specific gravity, compressive strength, and leaching tests were carried out to study the properties of these bricks.

The compressive strength of the brick ranged from 6.25 MPa to 0.33 MPa and indicates a decreasing pattern in strength with the increase in the volume of Dyeing Sludge and Fly Ash. Only 18.8% water absorption capacity was found in control bricks without Dyeing Sludge and Fly Ash, while a maximum absorption of 40.19% was found for a particular combination of Dyeing Sludge and Fly Ash. Similarly, dry density decreased with the increase in the volume of Dyeing Sludge and Fly Ash. Besides, efflorescence in bricks was found within the allowable limits for certain combinations of Dyeing Sludge and Fly Ash, which exceeded the allowable limits for other combinations. The presence of heavy metals (Ni, Zn, Cr, Cu, and Pb) in the extraction solution was insignificant. Based on the results of this study, we recommend that up to 10% clay can be substituted with Dyeing Sludge and Fly Ash without substantially affecting the quality of bricks. With an increase interest in recycling and reusing waste, there is need to carry out our research on exploring ways. Even to analyze the sludge generation can be studied way to transform industrial waste into construction materials. Textile sludge was incorporated with fly ash brick manufacturing.

10. Determination of calorific value using bomb calorimeter
11. Determination of nitrite in water.

S. No.	Description of Equipment	Quantity required
1	Silica Crucible	20
2	Heating Mantle	3
3	Muffle Furnace	1
4	Hot air oven	1
5	Desiccator	5
6	Vacuum Pump	1
7	Condenser	10
8	Reflux Condenser	10
9	Pensky martens closed cup apparatus	1
10	Cleveland Open cup apparatus	1
11	Cloud point apparatus	1
12	Saybolt Viscometer	1
13	Redwood Viscometer	1
14	Bomb Calorimeter	1
15	COD reflux	1
16	Orsat apparatus	1
17	UV-Vis Spectrophotometer	1

TOTAL: 60 PERIODS

OUTCOMES:
- Familiarization with equipment like viscometers, flash and fire point apparatus etc
- Familiarization of methods for determining COD
- Familiarization of a few simple synthetic techniques for soap

REFERENCES:

1. Environmental pollution analysis, S.M.Khopkar, New age international. 2011
2. Manual of environmental analysis, N.C Aery, Ane books. 2010
3. Text book of quantitative chemical analysis, J.Mendham, Pearson education 2008

CH8591 HEAT TRANSFER L T P C
3 2 0 4

OBJECTIVE:
- To enable the students to learn heat transfer by conduction, convection and radiation and heat transfer equipments like evaporator and heat exchanger

UNIT I 15

Importance of heat transfer in Chemical Engineering operations - Modes of heat transfer -

Fourier's law of heat conduction - one dimensional steady state heat conduction equation for flat plate, hollow cylinder, - Heat conduction through a series of resistances - Thermal conductivity measurement; effect of temperature on thermal conductivity; Heat transfer in extended surfaces.

UNIT II **15**

Concepts of heat transfer by convection - Natural and forced convection, analogies between transfer of momentum and heat - Reynold's analogy, Prandtl and Coulburn analogy. Dimensional analysis in heat transfer, heat transfer coefficient for flow through a pipe, flow past flat plate, flow through packed beds.

UNIT III **15**

Heat transfer to fluids with phase change - heat transfer from condensing vapours, drop wise and film wise condensation, Nusselt equation for vertical and horizontal tubes, condensation of superheated vapours, Heat transfer to boiling liquids - mechanism of boiling, nucleate boiling and film boiling.

UNIT IV **15**

Theory of evaporation - single effect and multiple effect evaporation - Design calculation for single and multiple effect evaporation. Radiation heat transfer - Black body radiation, Emissivity, Stefan - Boltzmann law, Plank's law, radiation between surfaces.

UNIT V **15**

Log mean temperature difference - Single pass and multipass heat exchangers; plate heat exchangers; use of correction factor charts; heat exchangers effectiveness; number of transfer unit - Chart for different configurations - Fouling factors

TOTAL: 75 PERIODS

OUTCOMES:

At the end of this course,

- The students would have knowledge in various heat transfer methodology in process engineering.
- To design heat transfer equipments such as furnace, boilers, heat exchangers evaporation

TEXT BOOKS:

1. Holman, J. P., 'Heat Transfer ', 8th Edn., McGraw Hill, 1997.
2. Ozisik, M. N., Heat Transfer: A Basic Approach, McGraw-Hill, 1984
3. Kern, D.Q., "Process Heat Transfer ", McGraw-Hill, 1999.

REFERENCES:

1. McCabe, W.L., Smith, J.C., and Harriot, P., "Unit Operations in Chemical Engineering", 6th Edn., McGraw-Hill, 2001.
2. Coulson, J.M. and Richardson, J.F., "Chemical Engineering " Vol. I, 4th Edn., Asian Books Pvt. Ltd., India, 1998.

CH8551	**MASS TRANSFER I**	**L T P C**
		3 0 0 3

OBJECTIVE:

- Students will learn to determine mass transfer rates under laminar and turbulent conditions.

UNIT I **9**

Introduction to mass transfer operations; Molecular diffusion in gases, liquids and solids; diffusivity measurement and prediction; multi-component diffusion.

DESIGN COMPARISON OF ETHYLENE GLYCOL AND TRI ETHYLENE GLYCOL DEHYDRATION

A Project Report

Submitted by

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Mohamed Aashik H	**712819139011**
Vignesh R	**712819139029**
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ANNA UNIVERSITY: CHENNAI 600 025

MAY 2023

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BONAFIDE CERTIFICATE

Certified that this project report **"DESIGN COMPARISON OF ETHYLENE GLYCOL AND TRI ETHYLENE GLYCOL DEHYDRATION"** is the bonafide work of **"MICHEAL SAJIN J, MOHAMED AASHIK H, VIGNESH R, SATHIK AHAMED S"** who carried out the project work under my supervision.

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PROFESSOR AND HEAD

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Submitted for the project Viva-Voice examination held on 22.05.2023

INTERNAL EXAMINER

EXTERNAL EXAMINER

ABSTRACT

Glycol dehydration is a widely used method for the removal of water from natural gas, using glycol as a solvent to absorb water from the gas stream. The presence of water will promote the occurrence of corrosion and hydrate formation along the gas pipelines. Tri-Ethylene Glycol (TEG) is commonly used as the solvent for glycol dehydration. The main environmental concern of this TEG process is the emission of benzene, toluene, ethylbenzene, and xylene (BTEX) compounds to the atmosphere.

This study will be using Mono-Ethylene Glycol (MEG) as the solvent, where the objectives are to compare the performance of MEG with TEG, mainly in reducing the amount of BTEX emissions. The scopes of this study are the simulation of three glycol dehydration technologies which are basic, Stahl, and Drizo. MEG will be used as the dehydrating agent in this study, and optimization of operating conditions is done in order to have an optimized process operation of MEG.

The data and results are obtained by process modeling using the Aspen Hysys simulation package. Performance of MEG is evaluated and compared with TEG. Based on our analysis we can see that the usage of MEG significantly reduced the amount of BTEX emissions without any need of equipment addition for the same glycol dehydration technology, where the amount of emission is almost zero. However, usage of MEG will result in higher amount of glycol losses. If MEG is used, it must be determined if the cost of glycol replacement is less than the cost of treating the BTEX emissions.

UNIT II **10**

Eddy diffusion, concept of mass transfer coefficients, theories of mass transfer, different transport analogies, application of correlations for mass transfer coefficients, inter phase mass transfer, relationship between individual and overall mass transfer coefficients. NTU and NTP concepts, Stage-wise and differential contractors.

UNIT III **9**

Humidification – Equilibrium, humidity chart, adiabatic and wet bulb temperatures; humidification operations; theory and design of cooling towers, dehumidifiers and humidifiers using enthalpy transfer unit concept.

UNIT IV **9**

Drying– Equilibrium; classification of dryers; batch drying – Mechanism and time of cross through circulation drying, continuous dryers – material and energy balance; determination of length of rotary dryer using rate concept.

UNIT V **8**

Crystallization - Equilibrium, classification of crystallizers, mass and energy balance; kinetics of crystallization – nucleation and growth; design of batch crystallizers; population balance model and design of continuous crystallizers.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course,

- Students would have knowledge in diffusion and its application in laminar and turbulent conditions.
- Students would apply the mass transfer concepts in the design of humidification columns, dryers and crystallizers.

TEXT BOOKS:

1. Treybal, R.E., "Mass Transfer Operations", 3rd Edn, McGraw-Hill, 1981.
2. Geankoplis, C.J., "Transport Processes and Unit Operations", 4th Edition, Prentice Hall Inc., New Jersey, 2003.
3. McCabe, W.L., Smith, J.C., and Harriot, P., "Unit Operations in Chemical Engineering", 7th Edn., McGraw-Hill, 2005.

REFERENCES:

1. Coulson, J.M. and Richardson, J.F., "Chemical Engineering" Vol. I and II, 4th Edition, Asian Books Pvt. Ltd., India, 1998.
2. J.D. Seader and E.J. Henley, "Separation Process Principles", 2nd Ed., John Wiley, 2006.
3. Binay K. Dutta, "Principles of Mass Transfer and Separation Processes", PHI Learning Ltd, 2013.

PE8091	**CHEMICAL REACTION ENGINEERING**	**L T P C**
		3 0 0 3

OBJECTIVE:

- To enable the students to gain knowledge on different types of chemical reactors, the design of chemical reactors under isothermal and non-isothermal conditions

UNIT I **9**

Rate equation, elementary, non-elementary reactions, theories of reaction rate and Prediction; Design equation for constant and variable volume batch reactors, analysis of experimental kinetics data, integral and differential analysis.

UNIT II **9**

Design of continuous reactors - stirred tank and tubular flow reactor, recycle reactors, Equal sized CSTRs in series and parallel, Equal sized PFRs in series and parallel,size comparison of reactors.

UNIT III **9**

Design of reactors for multiple reactions - consecutive, parallel and mixed reactions - factors affecting choice, optimum yield and conversion, selectivity, reactivity and yield.

UNIT IV **9**

Non-isothermal homogeneous reactor systems, adiabatic reactors, rates of heat exchanges for different reactors, design for constant rate input and constant heat transfer coefficient, operation of batch and continuous reactors, optimum temperature progression.

UNIT V **9**

The residence time distribution as a factor of performance; residence time functions and relationship between them in reactor; basic models for non-ideal flow; conversion in non-ideal reactors

TOTAL: 45 PERIODS

OUTCOME:

- At the end of this course, the students would gain knowledge on the selection of reactor for the required reaction.

TEXT BOOKS:

1. Levenspiel O, “Chemical Reaction Engineering”, Wiley Eastern Ltd., II Edition, 2000.
2. Smith, J.M, “Chemical Engineering Kinetics”, McGraw Hill, III Edition, 1981.
3. Fogler.H.S., “Elements of Chemical Reaction Engineering”, Prentice Hall of India Ltd., 3rd Edition, 2000.

REFERENCE:

1. Froment. G.F. &K.B.Bischoff, “Chemical Reactor Analysis and Design”, John Wiley and Sons, 1979.

HS8581 **PROFESSIONAL COMMUNICATION** **L T P C**
0 0 2 1

OBJECTIVES:

The couse aims to:

- Enhance the Employability and Career Skills of students
  - Orient the students towards grooming as a professional
- Make them Employable Graduates
- Develop their confidence and help them attend interviews successfully

UNIT I

Introduction to Soft Skills-- Hard skills & soft skills - employability and career Skills—Grooming as a professional with values—Time Management—General awareness of Current Affairs

UNIT II

Self-Introduction-organizing the material - Introducing oneself to the audience – introducing the topic – answering questions – individual presentation practice— presenting the visuals effectively – 5 minute presentations

FLUID CATALYTIC CRACKING UNIT SIMULATION USING ASPEN HYSYS

A PROJECT REPORT

Submitted by

BALA MURUGAN K 712819139006

NANDHAKISHORE M 712819139014

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SURIYARAJESWARAN D 712819139027

In partial fulfillment for the award of the degree

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PROGRESS THROUGH KNOWLEDGE

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MAY 2023

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BONAFIDE CERTIFICATE

Certified that this project report **"FLUID CATALYTIC CRACKING UNIT SIMULATION USING ASPEN HYSYS"** is the bonafide work of **" BALA MURUGAN K, NANDHAKISHORE M, NAYAGASUDHAN G, SURIYARAJESWARAN D,** who carried out the project work under my supervision.

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402

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Submitted for the project Viva-voce examination held on 22-05-2023

INTERNAL EXAMINER

EXTERNAL EXAMINER

ABSTRACT

The Fluid Catalytic Cracking (FCC) unit is a crucial process in the petroleum refining industry for converting heavy hydrocarbon feedstock into valuable lighter products. Simulation plays a vital role in understanding and optimizing the performance of the FCC unit. This abstract provides an overview of simulating an FCC unit using Aspen HYSYS, widely used process simulation software. The simulation of an FCC unit in Aspen HYSYS involves creating a process flow diagram (PFD) that represents the unit's various components and their interconnections. The PFD includes the reactor, regenerator, fractionator, cyclones, separators, and other equipment. The catalyst and hydrocarbon feedstock properties are specified, and appropriate thermodynamic models and kinetic reactions are selected to accurately represent the cracking reactions and catalyst behavior. The kinetic models account for catalyst deactivation, coke formation, and regeneration reactions. The PFD is further configured with heat exchangers, pumps, compressors, and other utilities required for energy integration and efficient operation. Stream properties, operating conditions, and equipment specifications are defined based on plant data or design requirements. Once the PFD is set up, the simulation is performed by solving the mass and energy balance equations using rigorous numerical methods. The simulation results provide valuable insights into key performance parameters such as product yields, catalyst activity, temperatures, pressures, and other process variables. Sensitivity analyses can be conducted to evaluate the effects of different operating conditions, catalyst properties, or feedstock compositions on the FCC unit's performance. Optimization techniques within Aspen HYSYS can be employed to maximize desired product yields, minimize energy consumption, or meet specific product specifications. Simulation using Aspen HYSYS enables engineers and operators to understand the complex interactions within the FCC unit, assess the impact of process changes, and identify opportunities for improvement. It aids in troubleshooting operational issues, optimizing catalyst usage, and evaluating the economic feasibility of process modifications. In conclusion, simulation of the Fluid Catalytic Cracking unit using Aspen HYSYS provides a comprehensive tool to model and analyze the unit's performance. It facilitates process optimization, enhances understanding of the unit's behavior, and assists in decision-making for improving efficiency, product quality, and profitability in the FCC process.

Keywords: Aspen HYSYS, FCC Unit, Simulation, Fractionator, Reactor

9. Heat transfer by Single effect evaporation / Multiple effect evaporation
10. Boiling Heat Transfer
11. Heat Transfer through Packed Bed
12. Heat Transfer in a Horizontal Condenser / Vertical Condenser
13. Heat Transfer in Helical Coils
14. Heat Transfer in Agitated Vessels

TOTAL: 60 PERIODS

Minimum 10 experiments to be offered

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

1.	Double Pipe Heat Exchanger	1 No.
2.	Shell and Tube heat exchanger	1 No.
3.	Bare and Finned Tube Heat Exchanger	1 No.
4.	Composite wall set up	1 No.
5.	Natural convection set up or Forced convection set up	1 No.
6.	Stefan Boltzmann Apparatus	1 No.
7.	Emissivity measurement set up	1 No.
8.	Open Pan Evaporator	1 No.
9.	Single effect evaporator or Multiple effect evaporator	1 No.
10.	Boiler	Compulsory equipment
11.	Packed Bed	1 No.
12.	Vertical Condenser or Horizontal Condenser	1 No.
13.	Helical Coil	1 No.
14.	Agitated Vessel	1 No.
15.	Jacketed vessel	1 No.

Any 10 equipment excluding boiler

OUTCOME:

- Student would be able to calculate heat transfer by conduction, different types of convection using classical models for these phenomena.

PM8561 PETROCHEMICAL ANALYSIS LABORATORY **L T P C**
0 0 4 2

OBJECTIVE:

- To learn basic principles involved in analysis of petrochemical products.

LIST OF EXPERIMENTS

1. Sulphur content determination
2. Flue gas Analysis – Orsat Apparatus
3. Aromatic Content determination
4. Determination of Lead, Acid and Salt content
5. Analysis of petrochemicals using UV spectrophotometer
6. Analysis of petrochemicals using NMR with MS
7. Analysis of petrochemicals using Gas chromatography
8. Biodegradation of petrochemicals
9. Bioremediation of petrochemicals

10. Refractive index of petrochemicals
11. Determination of moisture content – KF Titrator
12. Total acidity determination
13. Dynamic viscosity measurement
14. Calorific value of fuels

TOTAL:60 PERIODS

OUTCOMES:

- Carry out experiments as a team to acquire knowledge about physical and chemical characterization of petrochemical products and apply their knowledge in industries.
- Perform the advanced qualitative and quantitative laboratory tasks, including the operation of advanced analytical instrumentation.

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

1. Bomb calorimeter
2. ORSAT apparatus
3. UV- Visible spectrophotometer.
4. Gas Chromatography
5. Sulphur content determination instrument
6. NMR
7. Dynamic Viscometer
8. KF-Titrator
9. Refractometer
10. Laminar flow chamber
11. COD Incubator
12. BOD Incubator and shaker
13. Bacteriological chamber
14. Atomic absorption Spectrophotometer

PM8651 PETROLEUM SECONDARY PROCESSING TECHNOLOGY L T P C
3 0 0 3

OBJECTIVE:

- Students will learn the refining operations like cracking, reforming, alklylation, isomerization and coking

UNIT I THERMAL CRACKING AND COKING 9

Need and significance, types and functions of Secondary Processing. Cracking, Thermal Cracking and Visbreaking. Different Feed Stocks, Products Yields, Qualities and Recent Development. Hydro Cracking- principles, reactions in Hydro Cracking, Catalyst, Hydro Cracking Reaction Conditions, Iso Max Processes and Hydro Desulphurization Processes. Methods of Petroleum Coke Production – Koppers, Thermal Cracking, Delayed Coking, Fluid Coking and Contact Coking.

UNIT II CATALYTIC CRAKING AND HYDRO CRACKING 9

Catalytic Cracking, Commercial Catalyst, Feedstock and Catalytic Cracking Conditions, Types and Processes- Fixed Bed Cracker, Fluid Catalytic Cracking (FCC), Flexi Cracking.

UNIT III CATALYTIC REFORMING 9

Theory, Reaction Conditions and Catalyst for Catalytic Reforming, Platforming, Houdri Forming, Rhein Forming, Power Forming, Selecto Forming. Ultra Forming and Rex Forming. Naphtha Cracking, Feedstock Selection and Effect of Steam.

OIL PRODUCTION FORECASTING USING MACHINE LEARNING

A PROJECT REPORT

Submitted by

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MUHAMMED SALMAN A 712819139013

in partial fulfillment for the award of the degree

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BACHELOR OF ENGINEERING

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PETROCHEMICAL ENGINEERING

PROGRESS THROUGH KNOWLEDGE

RVS COLLEGE OF ENGINEERING & TECHNOLOGY, COIMBATORE

ANNA UNIVERSITY: CHENNAI 600 025

MAY 2023

ANNA UNIVERSITY : CHENNAI 600 025

BONAFIDE CERTIFICATE

Certified that this project report "**OIL PRODUCTION FORECASTING USING MACHINE LEARNING**" is the bonafide work of "**AKSHAY SEKHAR R R, ATHUL KRISHNA K ,MUHAMMED SALMAN A**" who carried out the project work under my supervision.

SIGNATURE

Dr. KANNAN R. Ph.D.,

HEAD OF THE DEPARTMENT

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Viva voce held on 22/05/2023

22/5/23

INTERNAL EXAMINER

EXTERNAL EXAMINER

ABSTRACT

Oil production forecasting is a critical task in the petroleum industry, as accurate predictions can lead to better decision-making and higher profits. In recent years, machine learning (ML) techniques have been increasingly applied to this field due to their ability to process vast amounts of data and identify complex patterns. The dataset used in this study is a time series dataset that contains production data from Volve Field oil wells. The dataset was preprocessed to remove outliers and missing values, and features were engineered to capture the underlying trends and patterns.

The dataset was splitted and trained (70%) and evaluated (30%) on the with ML models linear regression and polynomial regression. The models were evaluated using R^2 performance metrics. The results showed that the polynomial regression correlates better than linear regression model, achieving an R^2 of around 0.95. This study demonstrates the potential of ML models in predicting oil production. Further research could explore the use of more advanced ML techniques, such as deep learning, and investigate the application of ML models to larger and more complex datasets.

The sample size of the oil production forecasting model has an effect on its performance. Larger samples are preferable to build a data driven model, as they can cover the feature space and increase the predicted performance. Machine learning analysis can also benefit from more data to strengthen the trained model's dependability.

Keywords: *Oil Production Prediction, Machine Learning, Linear Regression, Polynomial Regression, R-square value, Volve Field Data*

UNIT IV ALKYLATION AND ISOMERIZATION 9

Feed Stocks and Reactions for Alkylation Process- Cascade Sulphuric Acid Alkylation, Hydrofluoric Acid Alkylation. Isomerization Process- Isomerization with Platinum Catalyst and Aluminium Chloride Process.

UNIT V SPECIALTY PRODUCTS 9

Specialty Products: Industrial Grease- Manufacture of Calcium Grease, Liquid Paraffin and Petroleum Jellys. Polymer Gasoline: Feed Stock and Reactions of Polymer Gasoline

TOTAL: 45 PERIODS

OUTCOMES:

- Demonstrate knowledge on various secondary processing technologies available for improving the quality of the petroleum products.
- Understand different flow sheets, catalyst and reactor technologies to perform secondary processes.
- Select appropriate technologies to meet the specified needs of the industries with appropriate consideration for safety, environmental and society
- Understand and application of specialty products obtained from crude oil

TEXT BOOKS:

1. Jones, D.S.J. and Pujadó, P.R., Handbook of petroleum processing, Springer, The Netherlands, 2006
2. Nelson, W. L “Petroleum Refinery Engineering”, McGraw Hill Publishing Company Limited,1985.
3. Watkins, R. N “Petroleum Refinery Distillations”, 2nd Edition, Gulf Publishing Company, Texas, 1981.

REFERENCES:

1. Parkash, S., Refining processes handbook, Gulf Professional Publishing, 2003
2. Hobson, G. D “Modern Petroleum Refining Technology”, 4th Edition, Institute of Petroleum, U. K. 1973.

CH8651 MASS TRANSFER II L T P C

3 2 0 4

OBJECTIVE:

- To provide introduction to physical and thermodynamic principles of mass transfer with an emphasis on how these principles affect the design of equipment and result in specific requirements for quality and capacity.

UNIT I ABSORPTION 12

Gas Absorption and Stripping – Equilibrium; material balance; limiting gas-liquid ratio; tray tower absorber - calculation of number of theoretical stages, tray efficiency, tower diameter; packed tower absorber – rate based approach; determination of height of packing using HTU and NTU calculations.

UNIT II DISTILLATION 18

Vapour liquid equilibria - Raoult’s law, vapor-liquid equilibrium diagrams for ideal and non-ideal systems, enthalpy concentration diagrams. Principle of distillation - flash distillation, differential distillation, steam distillation, multistage continuous rectification, Number of ideal stages by Mc.Cabe - Thiele method and Ponchan - Savarit method, Total reflux, minimum reflux ratio, optimum reflux ratio. Introduction to multi-component distillation, azeotropic and extractive distillation

UNIT III LIQUID-LIQUID EXTRACTION 15

Liquid - liquid extraction - solvent characteristics-equilibrium stage wise contact calculations for batch and continuous extractors- differential contact equipment-spray, packed and mechanically agitated contactors and their design calculations-packed bed extraction with reflux. Pulsed extractors, centrifugal extractors-Supercritical extraction

UNIT IV LEACHING 12

Solid-liquid equilibria- leaching equipment for batch and continuous operations- calculation of number of stages - Leaching - Leaching by percolation through stationary solid beds, moving bed leaching, counter current multiple contact (shank's system), equipments for leaching operation, multi stage continuous cross current and counter current leaching, stage calculations, stage efficiency.

UNIT V ADSORPTION AND ION EXCHANGE & MEMBRANE SEPARATION PROCESS 18

Adsorption - Types of adsorption, nature of adsorbents, adsorption equilibria, effect of pressure and temperature on adsorption isotherms, Adsorption operations - stage wise operations, steady state moving bed and unsteady state fixed bed adsorbers, break through curves. Principle of Ion exchange, techniques and applications. Solid and liquid membranes; concept of osmosis; reverse osmosis; electro dialysis; ultrafiltration.

TOTAL:75 PERIODS

OUTCOME:

After completion of the curse, students will be able to

- Design absorber and stripper, distillation column.
- Design extraction, leaching equipments and adsorber.

TEXT BOOKS:

1. Wankat, P., "Equilibrium Stage Separations", Prentice Hall, 1993.
2. Treybal, R.E., "Mass Transfer Operations ", 3rd Edn., McGraw-Hill, 1981.
3. Geankoplis, C.J., "Transport Processes and Unit Operations", 4th Edition, Prentice Hall Inc., New Jersey, 2003.

REFERENCES:

1. Seader, J.D. and E.J. Henley, "Separation Process Principles", 2nd Ed., John Wiley,2006.
2. McCabe, W.L., Smith, J.C., and Harriot, P., "Unit Operations in Chemical Engineering", 7th Edn., McGraw-Hill, 2005.
3. King, C. J., "Separation Processes ", 2nd Edn., Tata McGraw-Hill 1980.

PE8072 CATALYTIC REACTION ENGINEERING L T P C
3 0 0 3

OBJECTIVE:

- To impart knowledge on different types of chemical reactors, the design of chemical reactors under isothermal and non-isothermal conditions

UNIT I CATALYST AND ITS CHARACTERIZATION 9

General definition of catalysts, Solid catalysts, Components of catalyst, Industrial catalysts, Preparation of solid catalysts, Precipitation and co-precipitation methods, Sol gel method, Supported catalysts,Impregnation and ion exchange method, Catalyst drying calcination and

SIMULATION OF MALEIC ANHYDRIDE PRODUCTION VIA PARTIAL OXIDATION OF N-BUTANE USING ASPEN HYSYS

A PROJECT REPORT

Submitted by

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In partial fulfillment for the award of the degree

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ANNA UNIVERSITY: CHENNAI 600 025

MAY 2023

ANNA UNIVERSITY: CHENNAI 600 025

BONAFIDE CERTIFICATE

Certified that this project report **"SIMULATION OF MALEIC ANHYDRIDE PRODUCTION VIA PARTIAL OXIDATION OF N-BUTANE USING ASPEN HYSYS"** is the bonafide work of **"PAUL SOLOMON X, RATHISH K, SALMAN A, SARAVANA KISHORE S"** who carried out the project work under my supervision.

SIGNATURE

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Submitted for the project Viva-Voice examination held on 22-05-2023

INTERNAL EXAMINER

EXTERNAL EXAMINAR

ABSTRACT

The documentation of the various technologies both correct and outdated for the production of maleic anhydride was performed the first place afterwards the modelling and simulation of a maleic anhydride process plant was carried out in this dissertation maleic anhydride is produced via n-butane partial oxidation the software used for the simulation is Aspen HYSYS. Technical data were collected from various sources such as patents and manuals

Throughout the simulation, there have been temperature restrictions concerning liquid mixtures of water and maleic anhydride in order to prevent reactions that lead maleic acid and fumaric acid gaseous mixtures and organic solvent interaction are considered as ideal mixtures. The production capacity of this plant is roughly 1,80,000metric tonnes per year.

The percentages higher than the 99% concerning product purity and recuperation were obtained as well as reactive losses of about 20%.

distillation

UNIT III LIQUID-LIQUID EXTRACTION 15

Liquid - liquid extraction - solvent characteristics-equilibrium stage wise contact calculations for batch and continuous extractors- differential contact equipment-spray, packed and mechanically agitated contactors and their design calculations-packed bed extraction with reflux. Pulsed extractors, centrifugal extractors-Supercritical extraction

UNIT IV LEACHING 12

Solid-liquid equilibria- leaching equipment for batch and continuous operations- calculation of number of stages - Leaching - Leaching by percolation through stationary solid beds, moving bed leaching, counter current multiple contact (shank's system), equipments for leaching operation, multi stage continuous cross current and counter current leaching, stage calculations, stage efficiency.

UNIT V ADSORPTION AND ION EXCHANGE & MEMBRANE SEPARATION PROCESS 18

Adsorption - Types of adsorption, nature of adsorbents, adsorption equilibria, effect of pressure and temperature on adsorption isotherms, Adsorption operations - stage wise operations, steady state moving bed and unsteady state fixed bed adsorbers, break through curves. Principle of Ion exchange, techniques and applications. Solid and liquid membranes; concept of osmosis; reverse osmosis; electro dialysis; ultrafiltration.

TOTAL:75 PERIODS

OUTCOME:

After completion of the curse, students will be able to

- Design absorber and stripper, distillation column.
- Design extraction, leaching equipments and adsorber.

TEXT BOOKS:

1. Wankat, P., "Equilibrium Stage Separations", Prentice Hall, 1993.
2. Treybal, R.E., "Mass Transfer Operations ", 3rd Edn., McGraw-Hill, 1981.
3. Geankoplis, C.J., "Transport Processes and Unit Operations", 4th Edition, Prentice Hall Inc., New Jersey, 2003.

REFERENCES:

1. Seader, J.D. and E.J. Henley, "Separation Process Principles", 2nd Ed., John Wiley,2006.
2. McCabe, W.L., Smith, J.C., and Harriot, P., "Unit Operations in Chemical Engineering", 7th Edn., McGraw-Hill, 2005.
3. King, C. J., "Separation Processes ", 2nd Edn., Tata McGraw-Hill 1980.

PE8072 CATALYTIC REACTION ENGINEERING L T P C
3 0 0 3

OBJECTIVE:

- To impart knowledge on different types of chemical reactors, the design of chemical reactors under isothermal and non-isothermal conditions

UNIT I CATALYST AND ITS CHARACTERIZATION 9

General definition of catalysts, Solid catalysts, Components of catalyst, Industrial catalysts, Preparation of solid catalysts, Precipitation and co-precipitation methods, Sol gel method, Supported catalysts,Impregnation and ion exchange method, Catalyst drying calcination and formulations, Catalyst Characterization techniques, Structural analysis, Chemisorption technique, Thermal analysis, Spectroscopic techniques, Microscopic technique.

UNIT II KINETICS OF HETEROGENEOUS CATALYTIC REACTIONS 9

Reaction mechanism and rate equations, Power law model, Langmuir-Hinshelwood –Hougen-Watson (LHHW) model, EleyRideal model, Rate controlling Step, Estimation of model parameters, Reactor types- Fixed bed reactor, Fluidised bed reactor, Berty Reactor, Multiphase Reactors- Slurry Reactor, Trickle bed reactor, Bioreactors, Catalysts tests.

UNIT III TRANSPORT PROCESSES WITH REACTIONS CATALYZED BY SOLIDS 9

Effect of external transport on catalytic reaction rate, Effect of external mass transfer resistance on order of reaction, Effect of external transport on selectivity, Effect of internal mass transport on catalytic reaction rate, Bulk diffusion , Knudsen diffusion, Surface diffusion,Effectiveness factor at isothermal conditions, Significance of intrapellet diffusion, Effect of intrapellet mass transfer on activation energy

UNIT IV CATALYST DEACTIVATION 9

Types of Catalyst Deactivation. Kinetics of Catalyst Poisoning. Kinetics of Catalyst Deactivation by Coke Formation.

UNIT V INDUSTRIAL CATALYTIC PROCESSES 9

Steam reforming, Catalytic cracking, Three Lumped kinetic model for catalytic cracking of gas oil Hydrocracking, Hydrogenation and Dehydrogenation Catalytic Reactions

TOTAL: 45 PERIODS

OUTCOME:

- At the end of this course, the students would gain knowledge on the selection of catalyst and multiphase reactor for the heterogeneous reaction.

TEXT BOOKS:

1. Chemical Reactor Analysis and Design, Gilbert F. Froment and Kenneth B. Bischoff, John Wiley & Sons, 2nd Edition, 1990.
2. Elements of Chemical Reaction Engineering, H. Scott Fogler, Prentice Hall International Series, 3rd Edition, 2000.

REFERENCES:

1. Chemical Reaction Engineering, Octave Levenspiel, John Wiley & Sons, 3rd Edition, 1999.
2. Fundamentals of Chemical Reaction Engineering, Mark E. Davis and Robert J.Davis, McGrawHill, 2003.
3. An Introduction to Chemical Engineering Kinetics & Reactor Design, Charles G. Hill, Jr., JohnWiley& Sons, 1977.

GE8076 PROFESSIONAL ETHICS IN ENGINEERING L T P C
3 0 0 3

OBJECTIVE:

- To enable the students to create an awareness on Engineering Ethics and Human Values, to instill Moral and Social Values and Loyalty and to appreciate the rights of others.

UNIT I HUMAN VALUES 10

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for

PRODUCTION OF BIODIESEL FROM *Pongamia pinnata* OILUSING NANO MAGNETIC ZrO2/CaO-Fe_3O_4 CATALYST

A PROJECT REPORT

Submitted by

AKHIL K M	**712819139001**
ANAND A	**712819139003**
INBASAGARAN R S	**712819139009**
SRIRAM V	**712819139025**

In partial fulfilment for the award 0f the degree

of

BACHELOR OF ENGINEERING

IN

PETROCHEMICAL ENGINEERING

RVS COLLEGE OF ENGINEERING AND TECHNOLOGY

COIMBATORE-641402

ANNA UNIVERSITY: CHENNAI 600 025

MAY 2023

ANNA UNIVERSITY: CHENNAI 600 025

BONAFIDE CERTIFICATE

Certified that this project report **"PRODUCTION OF BIODIESEL FROM *Pongamia pinnata* OIL USING NANO MAGNETIC ZrO2/CaO-Fe_3O_4 CATALYST"** is the bonafide work of **"AKHIL K M, ANAND A, INBASAGARAN R S, SRIRAM V** who carried out the project work under my supervision.

SIGNATURE	**SIGNATURE**
Dr. R. Kannan	**Dr. A. S. Arun Prasad**
PROFESSOR AND HEAD	**SUPERVISOR**
Department of Petrochemical Engg.	Department of Petrochemical Engg.
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Submitted for the project Viva-voce examination held on 22 · 5 · 2023

22/5/23

INTERNAL EXAMINER

22/5/23

EXTERNAL EXAMINER

ABSTRACT

Biodiesel production from *Pongamia pinnata* oil provides an alternative energy for various uses. Fe_3O_4 was prepared by co-precipitation method under 60°C and 400 rpm until it reaches a thick consistency and dried in hot air oven for 6 hrs maintaining the temperature at 150°C. The CaO was prepared from the mussel shells by calcination method under 300°C to 800°C in muffle furnace for 4 hrs. The nano-magnetic catalyst $ZrO_2/CaO-Fe_3O_4$ was prepared by doping. The prepared catalyst was characterized by FTIR, SEM, XRD and Particle size analyser to study their catalytic activity. It was transesterified using the $ZrO_2/CaO-Fe_3O_4$ catalyst at various experimental conditions: 5% (w/w) catalyst concentration, 12:1% of methanol to oil molar ratio, 65°C of reaction temperature and 50 min of reaction time which a maximum biodiesel yield of 98.11 wt% was obtained. The fuel properties were analysed of using ASTM D6751 standard. The prepared nano catalyst seems to be highly active in terms of quality and efficiency.

Keywords: *Pongamia pinnata* oil; Co-precipitation; Magnetic nano catalyst; Transesterification; Doping.

PE8661 PETROLEUM TESTING LABORATORY

	L	T	P	C
	0	0	4	2

OBJECTIVE:

- To make the student to be conversant with the theoretical principles and experimental procedures for quantitative estimation of petroleum products.

LIST OF EXPERIMENTS

1. Fluid viscosity determination
2. Carbon residue determination
3. Karl-Fisher Conductometer Apparatus for water estimation
4. Fluid density
5. Aniline point
6. Corrosion testing of petroleum oils and copper
7. Freezing point of Aqueous Engine coolant solution
8. Automatic Distillation
9. Fire point- Flash point
10. Gas Colorific value determination
11. liquid or solid Colorific value determination
12. Smoke point determination
13. Cloud and pour point determination
14. Softening point determination
15. Ductility of bitumen
16. Penetration index determination

TOTAL:60 PERIODS

OUTCOMES:

- Perform the various physical and chemical properties of the petroleum products in a safe manner.
- Differentiate various petroleum products by performing the specific tests.
- Perform the advanced qualitative and quantitative laboratory tasks, including the operation of advanced analytical instrumentation.

LIST OF EQUIPMENT

1. Redwood / Saybolt / Engler viscometer
2. Conradson Apparatus
3. Muffle furnace
4. Hydrometer
5. Aniline point apparatus
6. Copper corrosion Apparatus
7. Freezing / Cloud / Pour point apparatus
8. Junkers Gas Calorimeter / Bomb Calorimeter
9. Cleveland / PenskyMartien open and closed cup Flash and fire point Apparatus
10. API Distillation Apparatus
11. Abbey Refractometer
12. Dean and Stark apparatus
13. Karl –Fisher Apparatus
14. Softening point apparatus
15. Ductilometer
16. Penetrometer

INVESTIGATING THE IMPACT OF FUEL ADITIVES ON SPARK-IGNITED PETROL INTERNAL COMBUSTION ENGINES

A PROJECT REPORT

Submitted by

GEORGE G SAM	**712819139007**
ANANDU P	**712819139004**
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Of

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ANNA UNIVERSITY 600025

MAY 2023

ANNA UNIVERSITY: CHENNAI 600 025

BONAFIDE CERTIFICATE

Certified that this project report "**INVESTIGATING THE IMPACT OF FUEL ADITIVES ON SPARK-IGNITED PETROL INTERNAL COMBUSTION ENGINES**" is the bonafide work of "**GEORGE G SAM, ANANDU P, ADWAITH ANIL K, SURYA PRASAD E P**" who carried out the project work under my supervision.

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Submitted for project viva voce held on 22-05-2023

INTERNAL EXAMINER 22/5/23

EXTERNAL EXAMINER

ABSTRACT

Fuel additives have widespread global use and serve various purposes such as enhancing fuel efficiency, reducing emissions, minimizing the likelihood of knocking, and modifying storage and handling characteristics. Given the significant contribution of internal combustion engines to overall fossil fuel consumption worldwide, fuel additives that enhance the efficiency of these engines can have a substantial impact on global fossil fuel usage and greenhouse gas emissions. In this particular study, the influence of different fuel additive on spark-ignited petrol internal combustion engines was investigated. The main focus of the research was to explore the potential of fuel additives in extending the lean limit, decreasing the propensity for knocking, and increasing power. The experiments were conducted using a single-cylinder internal combustion engine with adjustable compression ratio, capable of running on both gaseous and liquid fuels. The liquid fuel system used a naturally aspirated carburetor. Cylinder pressure data were collected using a high-speed piezoelectric pressure transducer, enabling the calculation of indicated power, peak pressure, and quantification of engine knock. The study specifically examined petrol additives, aiming to determine whether they could enhance engine power, reduce knocking (indicated by an increase in the octane number), or extend the lean limit. This study investigated the possibilities of enhancing the quality of the petrol so that the consumption and the carbon emission caused by the combustion of petrol can be stabilized Most of the fuel efficiency enhancers are manufactured by blending chemicals/petrochemicals or by refining the existing fuel to enhance the octane level and for better combustion by adding alcohol. This study investigated the possibilities of enhancing the quality of the petrol so that the consumption and the carbon emission caused by the combustion of petrol can be stabilized Most of

the fuel efficiency enhancers are manufactured by blending chemicals/petrochemicals or by refining the existing fuel to enhance the octane level and for better combustion by adding alcohol.The results indicated that the additives improved engine efficiency and decreased the likelihood of knocking.

PM8751 PROCESS EQUIPMENT DESIGN AND DRAWING L T P C
3 0 2 4

(Chemical Engineers' Handbook/Data Books/Graph Sheets are permitted during the Examination.)

OBJECTIVES:

- To impart practical knowledge on the shape and drawing of the process equipments
- To become a design engineers on process equipments design and drawing consideration of the following:

UNIT I THERMODYNAMIC PROPERTIES EVALUATION FOR DESIGN 12

Physical properties evaluation, Thermodynamic properties of gases and binary mixtures– Methods of calculations –Vapour-liquid equilibrium data for ideal and non-ideal mixtures. Bubble points and dew points, flash distillation calculation.

UNIT II HEAT EXCHANGER DESIGN 15

Design of double pipe heat exchangers, Heat exchanger types and its selection – shell and tube heat exchangers and Condensers – Effectiveness – NTU method of heat exchanger analysis. Design of cooling towers.

UNIT III EVAPORATOR DESIGN 15

Steam – Uses of steam – Outstanding qualities of steam – BPE – Duhring's rule – Principle of multiple effect evaporation – Temperature driving force – Evaporators types and its selection – Design of single and multiple effect evaporators. Design of batch and continuous Dryers.

UNIT IV COLUMN DESIGN 18

Design of distillation columns, Absorption columns, Extraction column, and Adsorption columns.

UNIT V PUMPS, FANS AND COMPRESSORS 15

Pumps, fans and compressors – Types and its applications – Selection criteria - Characteristics – NPSHR and NPSHA – Power rating calculations based on process duty - Performance analysis of pumps, fans and compressors - Pump Cavitation. Surge problem in compressors.

TOTAL:75 PERIODS

OUTCOMES:

- Apply the skill in thermal design of heat transfer equipment like shell and tube, Double pipe heat Exchangers and evaporators, and assessing thermal efficiency of the above equipment in practice.
- Demonstrate the skills in basic design and drawing of different dryers, cooling towers and adsorption columns.
- Apply the concepts involved in phase separation and design of distillation, Extraction and absorption columns.

TEXT BOOKS:

1. Ernest E. Ludwig., "Applied Process Design for Chemical and Petrochemical Plants", Vol.I, II and III, Gulf Professional Publishing, 2002.
2. Dawande, S. D., "Process Design of Equiments", 4th Edition, Central Techno Publications, Nagpure, 2005.

REFERENCES:

1. Coulson, M. and Richardson, J.F., "Chemical Engineering", Vol.6, 3rd Edition, Pergamon Press, 1987.

FLUID CATALYTIC CRACKING UNIT SIMULATION USING ASPEN HYSYS

A PROJECT REPORT

Submitted by

BALA MURUGAN K	**712819139006**
NANDHAKISHORE M	**712819139014**
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in

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BONAFIDE CERTIFICATE

Certified that this project report **"FLUID CATALYTIC CRACKING UNIT SIMULATION USING ASPEN HYSYS"** is the bonafide work of **" BALA MURUGAN K, NANDHAKISHORE M, NAYAGASUDHAN G, SURIYARAJESWARAN D,** who carried out the project work under my supervision.

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INTERNAL EXAMINER

EXTERNAL EXAMINER

ABSTRACT

The Fluid Catalytic Cracking (FCC) unit is a crucial process in the petroleum refining industry for converting heavy hydrocarbon feedstock into valuable lighter products. Simulation plays a vital role in understanding and optimizing the performance of the FCC unit. This abstract provides an overview of simulating an FCC unit using Aspen HYSYS, widely used process simulation software. The simulation of an FCC unit in Aspen HYSYS involves creating a process flow diagram (PFD) that represents the unit's various components and their interconnections. The PFD includes the reactor, regenerator, fractionator, cyclones, separators, and other equipment. The catalyst and hydrocarbon feedstock properties are specified, and appropriate thermodynamic models and kinetic reactions are selected to accurately represent the cracking reactions and catalyst behavior. The kinetic models account for catalyst deactivation, coke formation, and regeneration reactions. The PFD is further configured with heat exchangers, pumps, compressors, and other utilities required for energy integration and efficient operation. Stream properties, operating conditions, and equipment specifications are defined based on plant data or design requirements. Once the PFD is set up, the simulation is performed by solving the mass and energy balance equations using rigorous numerical methods. The simulation results provide valuable insights into key performance parameters such as product yields, catalyst activity, temperatures, pressures, and other process variables. Sensitivity analyses can be conducted to evaluate the effects of different operating conditions, catalyst properties, or feedstock compositions on the FCC unit's performance. Optimization techniques within Aspen HYSYS can be employed to maximize desired product yields, minimize energy consumption, or meet specific product specifications. Simulation using Aspen HYSYS enables engineers and operators to understand the complex interactions within the FCC unit, assess the impact of process changes, and identify opportunities for improvement. It aids in troubleshooting operational issues, optimizing catalyst usage, and evaluating the economic feasibility of process modifications. In conclusion, simulation of the Fluid Catalytic Cracking unit using Aspen HYSYS provides a comprehensive tool to model and analyze the unit's performance. It facilitates process optimization, enhances understanding of the unit's behavior, and assists in decision-making for improving efficiency, product quality, and profitability in the FCC process.

Keywords: Aspen HYSYS, FCC Unit, Simulation, Fractionator, Reactor

2. Robert H. Perry and Don W. Green, "Perry's Chemical Engineer's Hand Book", 7th Edition, McGraw Hill – International, 1997. 3. Van Winkle, "Distillation Operations", McGraw Hill Publications, 1987.
3. D. Q. Kem, "Process Heat Transfer", Tata McGraw Hill Publishing Co., New Delhi, 1990.
4. Baranan, C.R., "Rules of Thumb for Chemical Engineers", Gulf Publishing Co,Texas, 1996.

GE8291 ENVIRONMENTAL SCIENCE AND ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To study the nature and facts about environment.
- To finding and implementing scientific, technological, economic and political solutions to environmental problems.
- To study the interrelationship between living organism and environment.
- To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
- To study the dynamic processes and understand the features of the earth"s interior and surface.
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY **14**

Definition, scope and importance of environment – need for public awareness - concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers – energy flow in the ecosystem – ecological succession – food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Field study of common plants, insects, birds; Field study of simple ecosystems – pond, river, hill slopes, etc.

UNIT II ENVIRONMENTAL POLLUTION **8**

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – solid waste management: causes, effects and control measures of municipal solid wastes – role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone and landslides. Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT III NATURAL RESOURCES **10**

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over- utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 7

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental organization- environmental ethics: Issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. – wasteland reclamation – consumerism and waste products – environment production act – Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act – enforcement machinery involved in environmental legislation- central and state pollution control boards- Public awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 6

Population growth. variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare – role of information technology in environment and human health – Case studies.

TOTAL: 45 PERIODS

OUTCOMES:

- Environmental Pollution or problems cannot be solved by mere laws. Public participation is an important aspect which serves the environmental Protection. One will obtain knowledge on the following after completing the course.
- Public awareness of environmental is at infant stage.
- Ignorance and incomplete knowledge has lead to misconceptions
- Development and improvement in std. of living has lead to serious environmental disasters

TEXT BOOKS:

1. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2006.
2. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.

REFERENCES:

1. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT LTD,New Delhi, 2007.
2. Erach Bharucha, "Textbook of Environmental Studies", Universities Press(I) PVT, LTD, Hydrabad, 2015.
3. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, 2005.
4. G. Tyler Miller and Scott E. Spoolman, "Environmental Science", Cengage Learning India PVT, LTD, Delhi, 2014.

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NATURAL GAS PROCESSING PLANT SIMULATION USING ASPEN HYSYS

A PROJECT REPORT

Submitted by

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BACHELOR OF ENGINEERING

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PETROCHEMICAL ENGINEERING

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MAY 2023

ANNA UNIVERSITY: CHENNAI 600 025

BONAFIDE CERTIFICATE

Certified that this project report **"NATURAL GAS PROCESSING PLANT SIMULATION USING ASPEN HYSYS"** is the bonafide work of **"ARUN KUMAR M, SANTHOSH KUMAR A, SEETHAPATHI P, SITHARTHAN V"** who carried out the project work under my supervision.

SIGNATURE	**SIGNATURE**
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PROFESSOR AND HEAD	**ASSOCIATE PROFESSOR**
	SUPERVISOR
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Submitted for the project Viva-Voice examination held on 22.05.2023

INTERNAL EXAMINER	**EXTERNAL EXAMINER**

Abstract

Natural gas is playing a growing energy role. The scale of its reverse and its environmental advantages favour its use, for fast growing activities such as the precision industries and the generation of electricity. The natural gas produced into the mainline gas transportation system must need specific quality measure in order for the pipeline grid to operate properly. Consequently, natural gas produced at the wellhead, which in most cases contains contaminates and natural gas liquids, must be processed, i.e., cleaned, before it can be safely delivered to high-pressure, long-distance pipe lines that transport the product to consuming public. Flowsheet development of the natural gas processing plant having capacity of 20MMSCFD which was undertaken using the Aspen HYSYS process simulator. The Simulation has been performed both in summer and winter cases. The steady state simulation of the gas processing plant shall be performed based on both the design and physical property data of the plant.

PM8761 REACTION ENGINEERING AND PROCESS CONTROL LABORATORY

L T P C
0 0 4 2

<u>REACTION ENGINEERING</u>:

OBJECTIVE:

- Students develop a sound working knowledge on different types of reactors.

LIST OF EXPERIMENTS*

1. Kinetic studies in a Batch reactor
2. Kinetic studies in a Plug flow reactor
3. Kinetic studies in a CSTR
4. Kinetic studies in a Packed bed reactor
5. Kinetic studies in a PFR followed by a CSTR
6. RTD studies in a PFR
7. RTD studies in a Packed bed reactor
8. RTD studies in a CSTR
9. Studies on micellar catalysis
10. Study of temperature dependence of rate constant using CSTR.
11. Kinetic studies in Sono chemical reactor
12. Batch reactive distillation
13. Kinetics of photochemical reaction
14. Demonstration of heterogeneous catalytic reaction
15. Demonstration of gas-liquid reaction

EQUIPMENT REQUIRED

1. BATCH REACTOR
2. Plug flow reactor
3. CSTR
4. Sono-chemical reactor
5. Photochemical reactor
6. Packed bed reactor

*Minimum 5 experiments shall be offered.

OUTCOMES

- Understand rate equation for different types of reactors.
- Design experiments in kinetics to determine conversion and effect of temperature on rate constant.
- Assess the performance of Plug flow Mixed flow and Packed bed by studying the residence time distribution.

<u>PROCESS CONTROL</u>:

OBJECTIVE:

- Students will gain the hands on training about the control systems

LIST OF EXPERIMENTS

1. Open loop study on a level system
2. Open loop study on a flow system
3. Open loop study on a thermal system
4. Closed loop study on a level system
5. Closed loop study on a flow system

SIMULATION OF MALEIC ANHYDRIDE PRODUCTION VIA PARTIAL OXIDATION OF N-BUTANE USING ASPEN HYSYS

A PROJECT REPORT

Submitted by

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ANNA UNIVERSITY: CHENNAI 600 025

BONAFIDE CERTIFICATE

Certified that this project report "**SIMULATION OF MALEIC ANHYDRIDE PRODUCTION VIA PARTIAL OXIDATION OF N-BUTANE USING ASPEN HYSYS**" is the bonafide work of "**PAUL SOLOMON X, RATHISH K, SALMAN A, SARAVANA KISHORE S**" who carried out the project work under my supervision.

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PROFESSOR AND HEAD	**SUPERVISOR**
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Submitted for the project Viva-Voice examination held on 22-05-2023

INTERNAL EXAMINER 22/5/23

EXTERNAL EXAMINAR

ABSTRACT

The documentation of the various technologies both correct and outdated for the production of maleic anhydride was performed the first place afterwards the modelling and simulation of a maleic anhydride process plant was carried out in this dissertation maleic anhydride is produced via n-butane partial oxidation the software used for the simulation is Aspen HYSYS. Technical data were collected from various sources such as patents and manuals

Throughout the simulation, there have been temperature restrictions concerning liquid mixtures of water and maleic anhydride in order to prevent reactions that lead maleic acid and fumaric acid gaseous mixtures and organic solvent interaction are considered as ideal mixtures. The production capacity of this plant is roughly 1,80,000metric tonnes per year.

The percentages higher than the 99% concerning product purity and recuperation were obtained as well as reactive losses of about 20%.

GE8073 **FUNDAMENTALS OF NANOSCIENCE** L T P C
3 0 0 3

OBJECTIVE:

- To learn about basis of nanomaterial science, preparation method, types and application

UNIT I INTRODUCTION 8

Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering-Classifications of nanostructured materials- nano particles- quantum dots, nanowires-ultra-thinfilms-multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).

UNIT II GENERAL METHODS OF PREPARATION 9

Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

UNIT III NANOMATERIALS 12

Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arc-growth, laser ablation, CVD routes, Plasma CVD), structure-property Relationships applications-Nanometal oxides-ZnO, TiO_2,MgO, ZrO_2, NiO, nanoalumina, CaO, $AgTiO_2$, Ferrites, Nanoclays-functionalization and applications-Quantum wires, Quantum dots-preparation, properties and applications.

UNIT IV CHARACTERIZATION TECHNIQUES 9

X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques-AFM, SPM, STM, SNOM, ESCA, SIMS-Nanoindentation.

UNIT V APPLICATIONS 7

NanoInfoTech: Information storage- nanocomputer, molecular switch, super chip, nanocrystal, Nanobiotechlogy: nanoprobes in medical diagnostics and biotechnology, Nano medicines, Targetted drug delivery, Bioimaging - Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)- Nanosensors, nano crystalline silver for bacterial inhibition, Nanoparticles for sunbarrier products - In Photostat, printing, solar cell, battery.

TOTAL: 45 PERIODS

OUTCOMES:

- Will familiarize about the science of nanomaterials
- Will demonstrate the preparation of nanomaterials
- Will develop knowledge in characteristic nanomaterial

TEXT BOOKS:

1. A.S. Edelstein and R.C. Cammearata, eds., "Nanomaterials: Synthesis, Properties and Applications", Institute of Physics Publishing, Bristol and Philadelphia, 1996.

PRODUCTION OF BIODIESEL FROM *Pongamia pinnata* OILUSING NANO MAGNETIC ZrO2/CaO-Fe_3O_4 CATALYST

A PROJECT REPORT

Submitted by

AKHIL K M	**712819139001**
ANAND A	**712819139003**
INBASAGARAN R S	**712819139009**
SRIRAM V	**712819139025**

In partial fulfilment for the award 0f the degree

of

BACHELOR OF ENGINEERING

IN

PETROCHEMICAL ENGINEERING

RVS COLLEGE OF ENGINEERING AND TECHNOLOGY

COIMBATORE-641402

ANNA UNIVERSITY: CHENNAI 600 025

MAY 2023

ANNA UNIVERSITY: CHENNAI 600 025

BONAFIDE CERTIFICATE

Certified that this project report **"PRODUCTION OF BIODIESEL FROM *Pongamia pinnata* OIL USING NANO MAGNETIC $ZrO2/CaO-Fe_3O_4$ CATALYST"** is the bonafide work of **"AKHIL K M, ANAND A, INBASAGARAN R S, SRIRAM V** who carried out the project work under my supervision.

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Submitted for the project Viva-voce examination held on 22 · 5 · 2023

22/5/23

INTERNAL EXAMINER

22/5/23

EXTERNAL EXAMINER

ABSTRACT

Biodiesel production from *Pongamia pinnata* oil provides an alternative energy for various uses. Fe_3O_4 was prepared by co-precipitation method under 60°C and 400 rpm until it reaches a thick consistency and dried in hot air oven for 6 hrs maintaining the temperature at 150°C. The CaO was prepared from the mussel shells by calcination method under 300°C to 800°C in muffle furnace for 4 hrs. The nano-magnetic catalyst $ZrO_2/CaO-Fe_3O_4$ was prepared by doping. The prepared catalyst was characterized by FTIR, SEM, XRD and Particle size analyser to study their catalytic activity. It was transesterified using the $ZrO_2/CaO-Fe_3O_4$ catalyst at various experimental conditions: 5% (w/w) catalyst concentration, 12:1% of methanol to oil molar ratio, 65°C of reaction temperature and 50 min of reaction time which a maximum biodiesel yield of 98.11 wt% was obtained. The fuel properties were analysed of using ASTM D6751 standard. The prepared nano catalyst seems to be highly active in terms of quality and efficiency.

Keywords: *Pongamia pinnata* oil; Co-precipitation; Magnetic nano catalyst; Transesterification; Doping.

UNIT IV SOLID STATE WELDING AND OTHER WELDING PROCESSES: 9

Cold welding, Diffusion bonding, Explosive welding, Ultrasonic welding, Friction welding, Forgewelding, Roll welding and Hot pressure welding processes - advantages, limitations and applications. Thermit welding, Atomic hydrogen welding, Electron beam welding, Laser Beam welding, Friction stirwelding, Under Water welding, Welding automation in aerospace, nuclear and surface transport vehicles.

UNIT V DESIGN OF WELD JOINTS, WELDABILITY AND TESTING OF WELDMENTS 9

Various weld joint designs – Weldability of Aluminium, Copper, and Stainless steels. Destructive andnon destructive testing of weldments.

TOTAL:45 PERIODS

OUTCOMES:

- Students gain knowledge on fundamentals of piping engineering, pipe hydraulics, piping supports . Upon completion of this course, the students can able to compare different types of Welding process for effective Welding of Structural components.

TEXT BOOKS

1. Piping Handbook, 6 th edition, M.L. Nayyar, P.E., Mc Graw-Hill, Inc
2. Piping Design Handbook edited by Johan J McKetta, CRC Press, 1992.
3. Luyben, W. L.," Process Modeling Simulation and Control for Chemical Engineers, McGraw Hill, 1990.
4. 4.Parmer R.S., “Welding Engineering and Technology”, 1st edition, Khanna Publishers, New
5. Delhi, 2008.
6. Parmer R.S., “Welding Processes and Technology”, Khanna Publishers, New Delhi, 1992.

PM8811	**PROJECT WORK**	**L T P C**
		0 0 20 10

OBJECTIVE:

- The objective of the project is to make use of the knowledge gained by the student at various stages of the degree course.

Each student is required to submit a report on the project assigned to him by the department. The report should be based on the information available in the literature or data obtained in the laboratory/industry.

Students, in addition to the home problem will be permitted to undertake industrial/ consultancy project work, outside the department, in industries/Research labs for which proportional weightage will be given in the final assessment.

PM8812	**SEMINAR**	**L T P C**
		0 0 4 2

The Objective of the comprehension test is to assess the overall level of proficiency and the scholastic attainment of the student in the various subjects studied during the degree course.

NATURAL GAS PROCESSING PLANT SIMULATION USING ASPEN HYSYS

A PROJECT REPORT

Submitted by

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MAY 2023

ANNA UNIVERSITY: CHENNAI 600 025

BONAFIDE CERTIFICATE

Certified that this project report "NATURAL GAS PROCESSING PLANT SIMULATION USING ASPEN HYSYS" is the bonafide work of "ARUN KUMAR M, SANTHOSH KUMAR A, SEETHAPATHI P, SITHARTHAN V" who carried out the project work under my supervision.

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Submitted for the project Viva-Voice examination held on 22.05.2023

22/05/23	22/05/23
INTERNAL EXAMINER	EXTERNAL EXAMINER
	(Dr S. ...)

Abstract

Natural gas is playing a growing energy role. The scale of its reverse and its environmental advantages favour its use, for fast growing activities such as the precision industries and the generation of electricity. The natural gas produced into the mainline gas transportation system must need specific quality measure in order for the pipeline grid to operate properly. Consequently, natural gas produced at the wellhead, which in most cases contains contaminates and natural gas liquids, must be processed, i.e., cleaned, before it can be safely delivered to high-pressure, long-distance pipe lines that transport the product to consuming public. Flowsheet development of the natural gas processing plant having capacity of 20MMSCFD which was undertaken using the Aspen HYSYS process simulator. The Simulation has been performed both in summer and winter cases. The steady state simulation of the gas processing plant shall be performed based on both the design and physical property data of the plant.