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INTERNATIONAL

SOY CONCLAVE

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BIODIESEL PROCESS - OPTIMIZATION

By

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DVC PROCESS TECHNOLOGISTS

CONSERVE ENERGY SAVE ENVIRONMENT

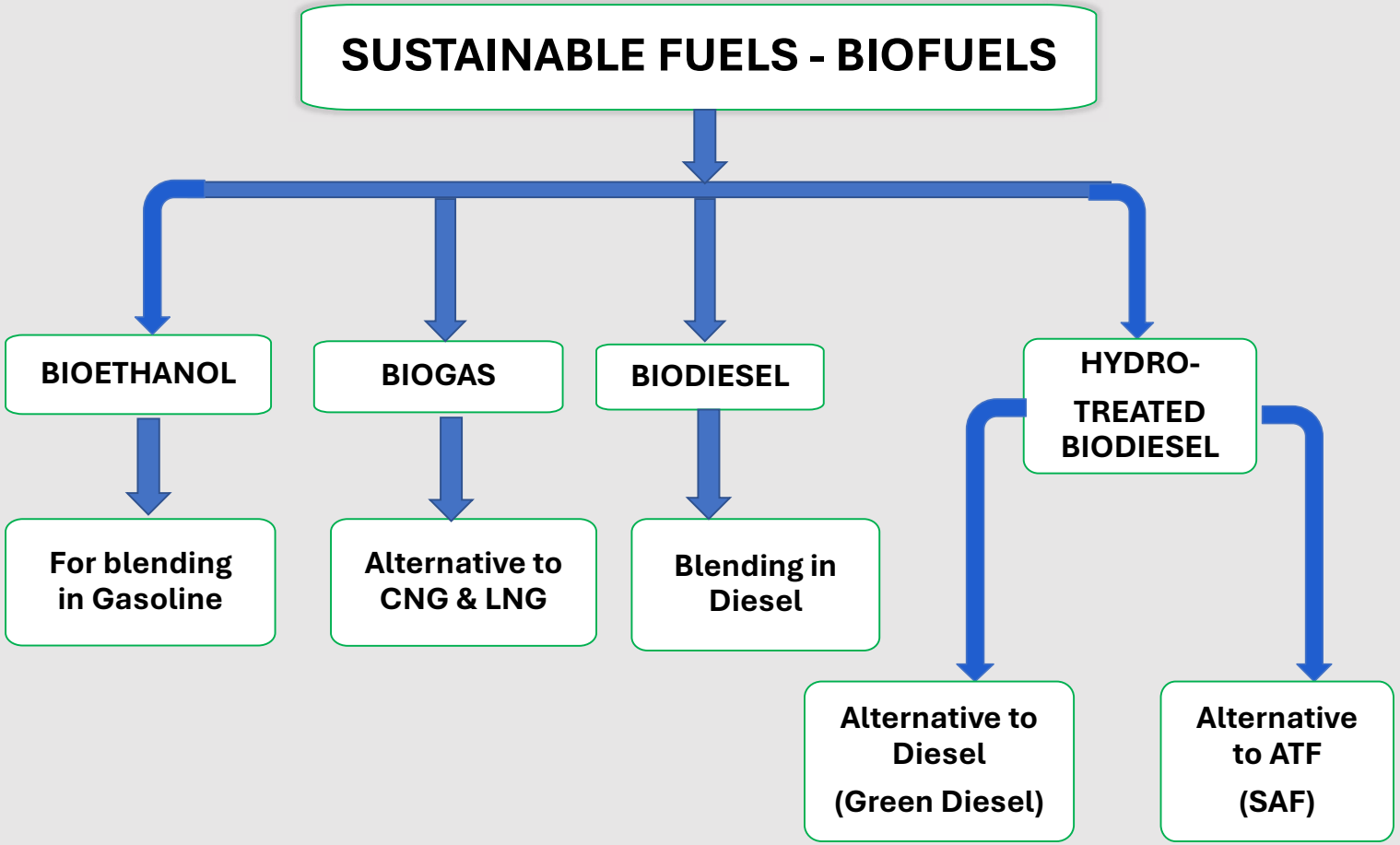
ABOUT US

- **DVC Process Technologists** established in year 2001, headquartered at Pune is a Technology & Innovation driven company, offers comprehensive processing solutions for Edible Oils and Fats, Oleo chemicals & Biodiesel Industries.
- Serving the industry with dedicated team of Technocrats and Engineers with vast experience in the Industry offering comprehensive solutions such as complete greenfield projects, independent processing sections, systematic upgradation of existing processing facility by way of its through technical audit
- Own equipment design and manufacturing facility, helps to deliver proven designs with quality key to success of projects & task undertaken
- **ISO Certified manufacturing facility.**

DVC's ACHIEVEMENTS & STRENGTHS

- Over 240+ references including Africa, Europe, USA, Australia & Middle East
- > 52 Green Field Projects
- Introduced Gums (Lecithin) Drying Plants for Rice Bran Oil.
- Value addition to the byproducts like deodorizer distillates by introducing two stage scrubbing
- Introducing the concept of zero liquid discharge from Refinery successfully
- Supplied PLC Automated 150 TPD continuous Biodiesel plant with multi feed stock technique & running successfully. Four more projects are under execution
- Most of the projects supplied are with PLC Automation by our own inhouse "Electrical & Process Automation Division"

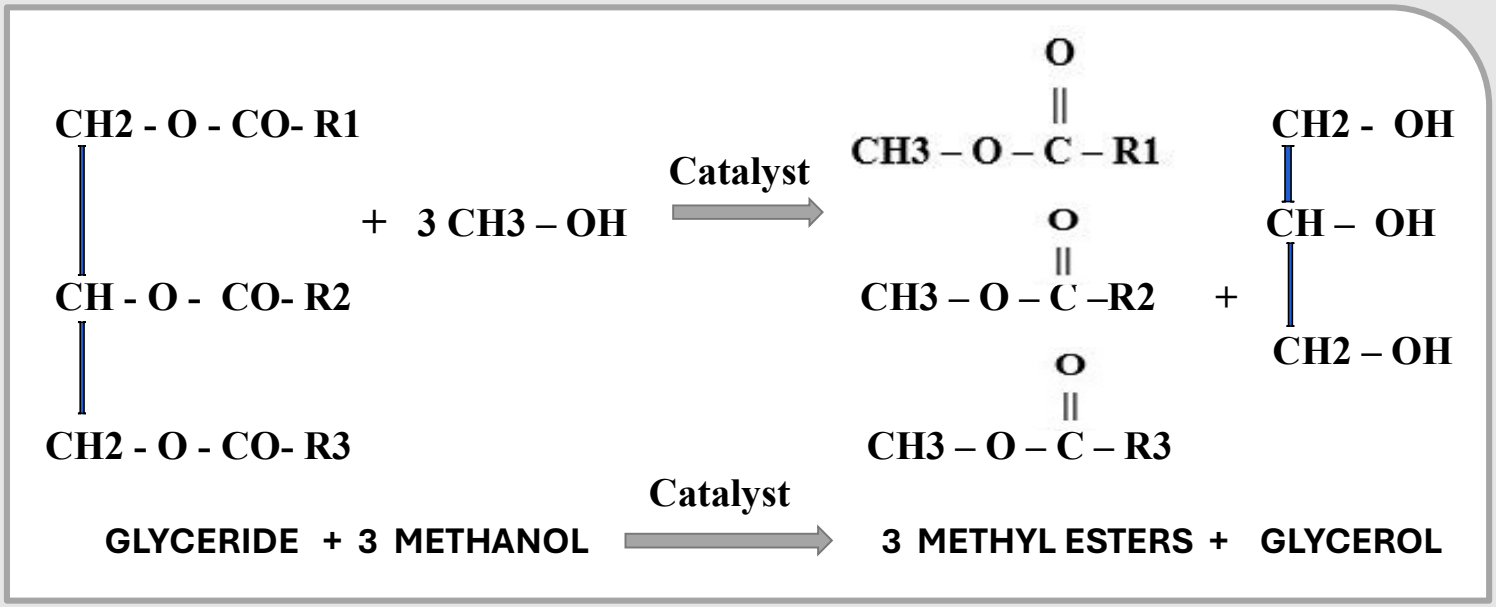
CLASSIFICATION OF SUSTAINABLE BIOFUELS :-



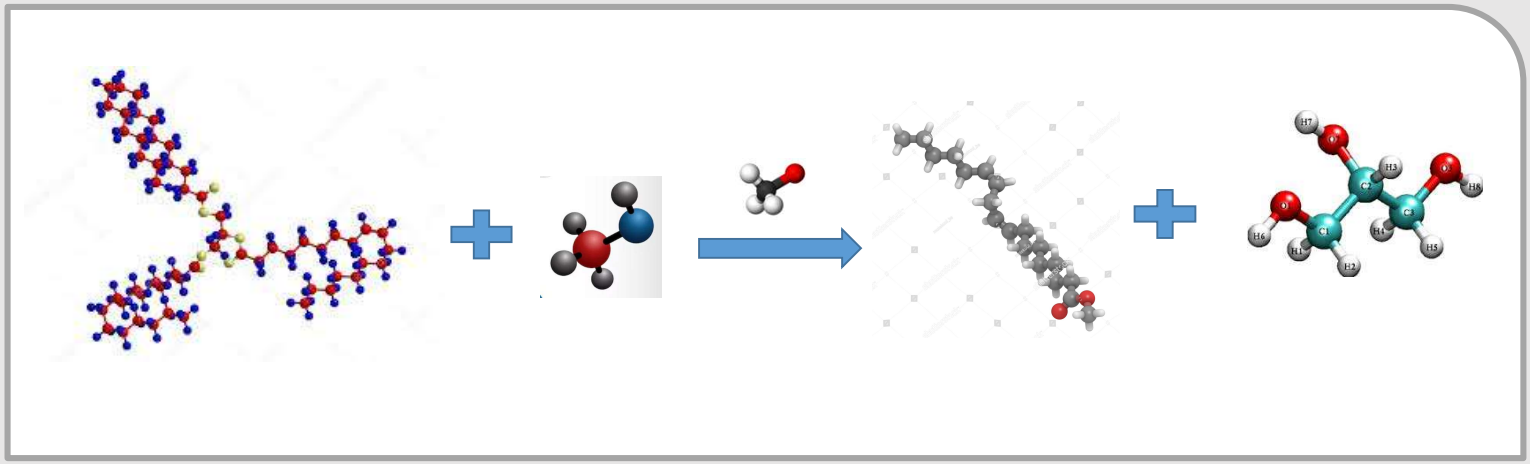
ABOUT BIODIESEL :-

- Biodiesel is a renewable, biodegradable fuel manufactured from Oils & Fats (vegetable / animal) and their products and byproducts like, palm stearin, refined palm oil, used cooking oil, fatty acid distillates, recovered oil, acid oil etc.

BIODIESEL FORMATION REACTION :-

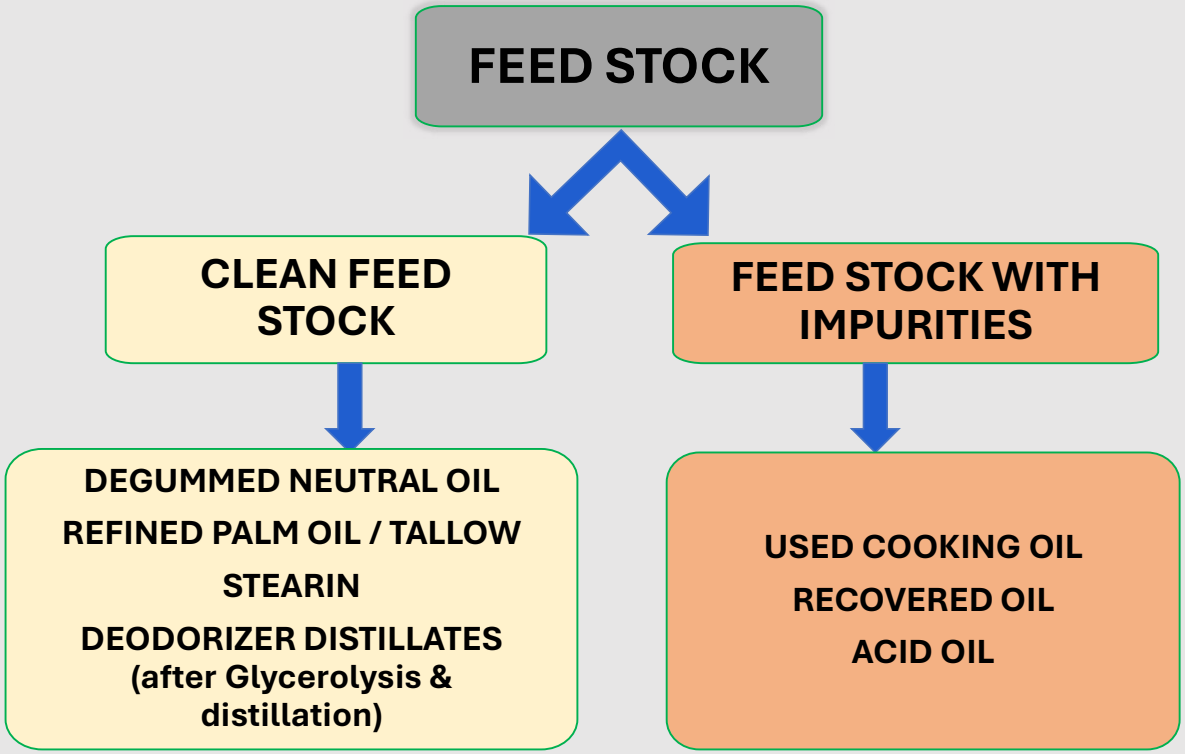


MOLECULAR STRUCTURE OF BIODIESEL FORMATION:-



(1) TRIGLYCERIDE + (3) METHANOL ⇨ (3) METHYL ESTER + (1) GLYCEROL

TYPES OF FEEDSTOCK FOR BIODIESEL PRODUCTION:-



CLEAN FEED STOCK - LOW FFA FEEDSTOCK

1. PALM STEARIN

- FFA < 0.2 %
- % Yield:- Up to 100 %

2. REFINED OIL

- FFA < 0.1- 0.2 %
- % Yield:- Up to 100 %

FEED STOCK WITH IMPURITIES HIGH FFA FEEDSTOCK

1. ACID OIL

- FFA 55 - 70%
- % Yield:- Up to 95%

2. CRUDE ANIMAL TALLOW

- FFA < 10 %
- % Yield:- Up to 99.5 %

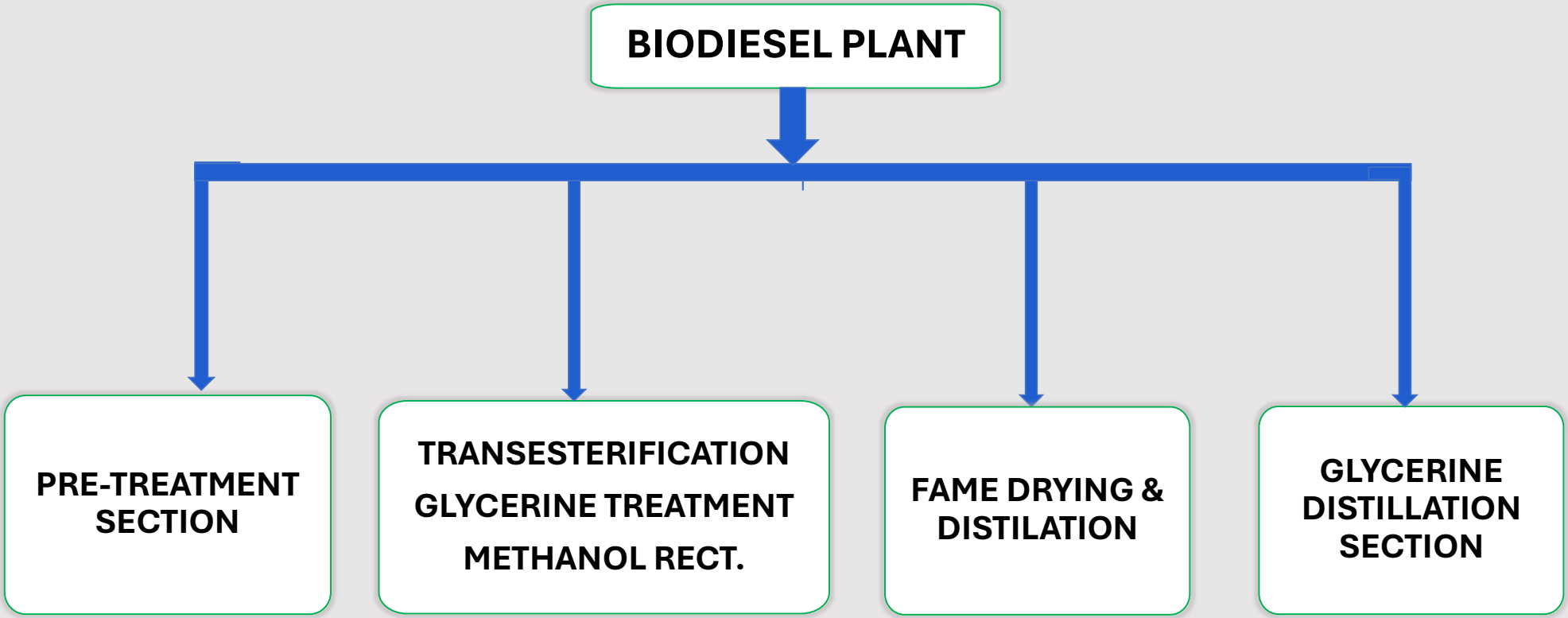
3. PALM FATTY ACID OIL / DISTILLATE

- FFA 80 - 88%
- % Yield:- Up to 97%

4. USED COOKING OIL

- FFA 4 – 8 %
- % Yield:- Up to 99 - 98 %

SECTIONS IN BIODIESEL PLANT :-



PRETREATMENT OF FEED STOCK CONTAINING IMPURITIES

A. DESLUDGING / DEGUMMING

Removal of gums and Insolubles in case of crude palm oil, animal tallow, used cooking oil by degumming. If UCO is high in sediments need to filter or de-sludge prior degumming

In case of acid oil / acid treated palm acid oil removal of sludge, gums & mineral acidity & sludge by desludging using decanters and for degumming using modified degumming processes like special degumming or enzymatic degumming

B. PRE-TREATMENT BLEACHING

Clean Feed stock or cleaned treated for residual gums and metal contaminants and getting further cleaned

C. DE-ACIDIFICATON

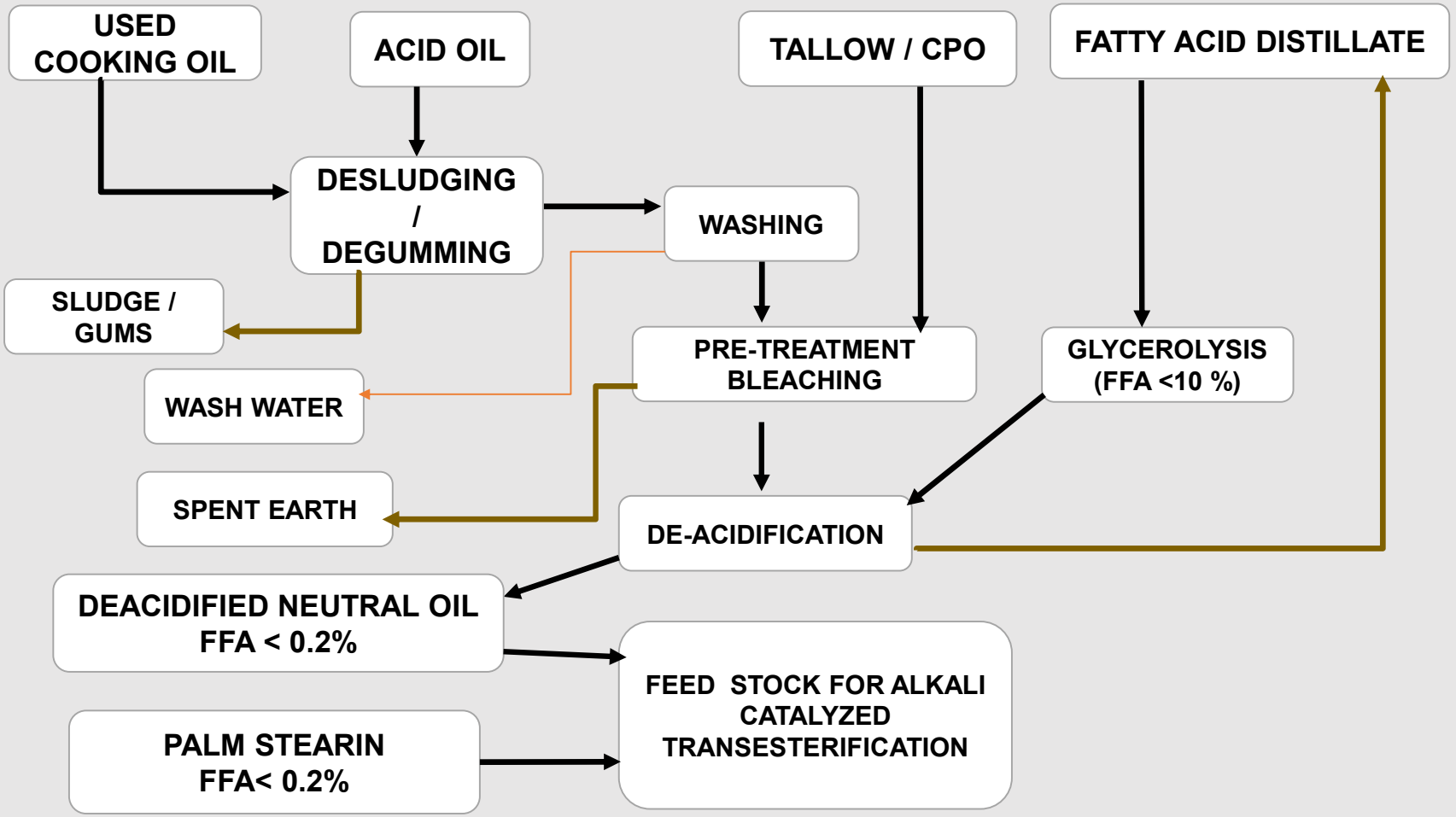
Cleaned feed stock lower in FFA < 30% subjected for deacidification to get near neutral stock with FFA < 0.2%

Incase of high FFA feed stock recommended to do Glycerolysis first and then de-acidification later to save on energy

D. GLYCEROLYSIS

Clean high FFA feed stocks as mentioned above are subjected to this process first and brought down FFA < 10% then passed through de-acidification stage to get required FFA < 0.2%

PROCESS FLOW SCHEME INDICATING STAGES IN PRETREATMENT



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TYPES OF TRANSESTERIFICATION PROCESSES

Which ever the process used for trans-esterification, but it its utmost requirement and priority to clean the feed stock prior subjecting to trans-esterification to form Fatty Acid Methyl Ester in short we call **FAME**

1. **ALKALI CATALYSED PROCESS**

   Here requirement is of having clean feed stock along with FFA < 0.2% to have lower catalyst consumption sodium methoxide NaOCH3 else catalyst consumed for bringing the mixture to neutral by neutralizing excessive FFA. In this process conversion achieved is up to 97% which don't required to further distilled! Acid value remains in control below 0.15%

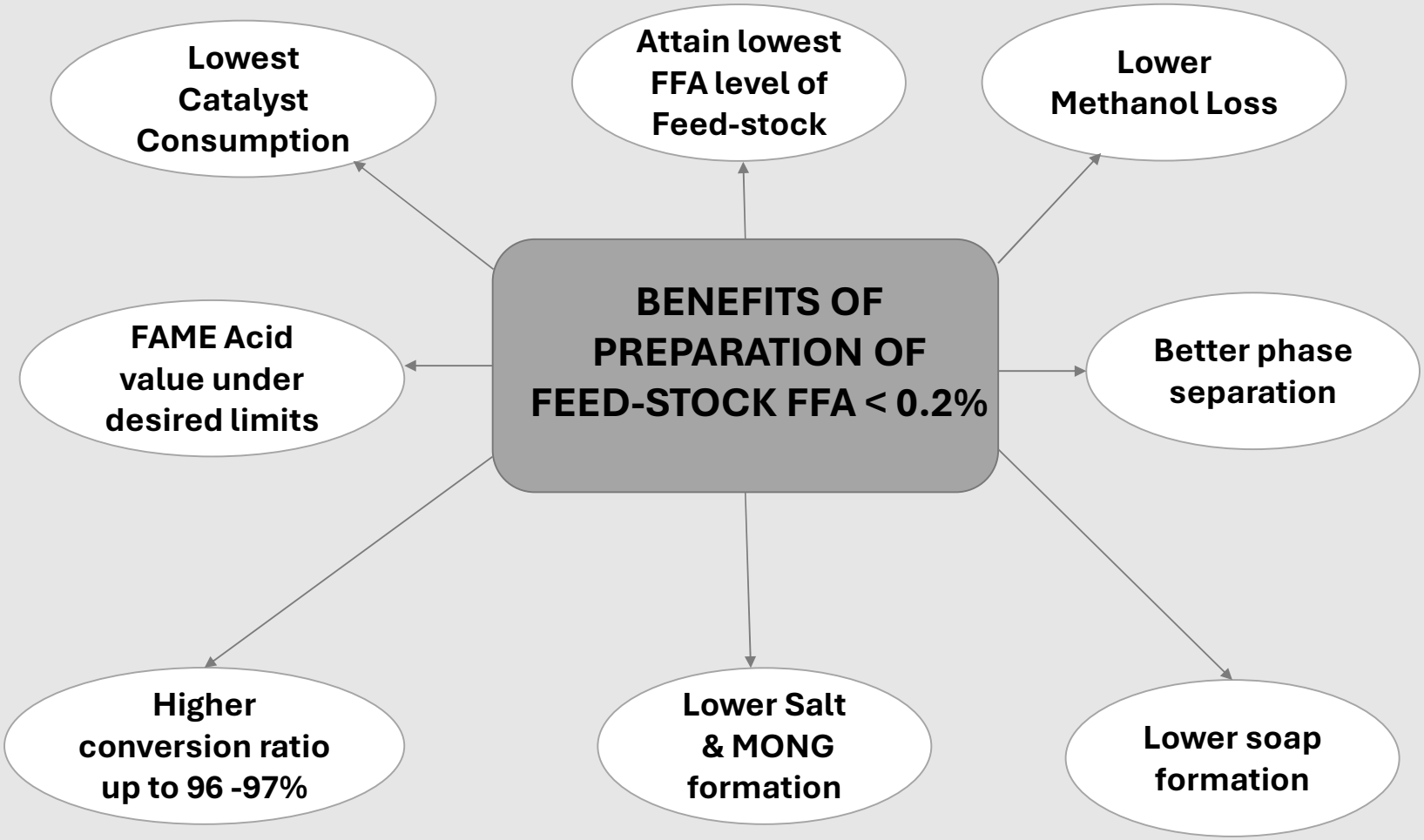
2. **ACID CATALYSED**

   In this process high FFA feed stock up to 90% can be processed but also required clean without any other undesirable impurities like gums & metal contaminants. Methanol concentration required is higher compared to previous process. Conversion takes place max to 90%, which further need to do treat like alkali neutralization to bring down acid value to acceptable level of < 0.15% then followed by distillation to separate unconverted glyceride part. Soap stock treatment is additional stage in processing.

3. **ENZYME CATALYSED**

   This can be used for high as well as low FFA feed stock but time required for conversion is high approx. 24 hours. Methanol concentration required here also is higher than first one. Conversion takes place up to 92% max even for neutral clean feed stock! So needs neutralization and distillation further to get removal of unconverted glyceride part.

NEAR NEUTRAL CLEAN FEED STOCK ADVANTAGES – ALKALI CATALYSED



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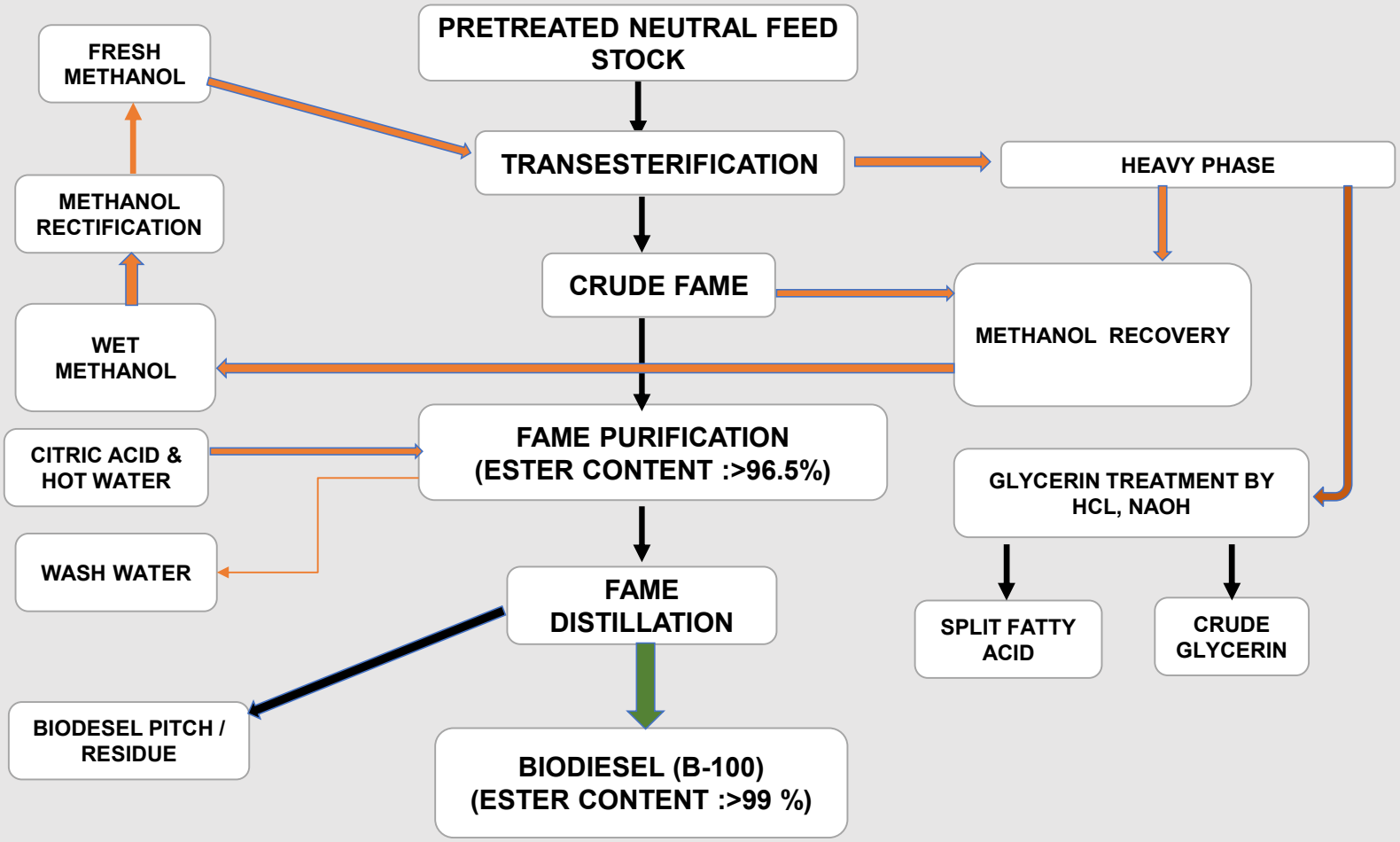
SECTIONS IN BIODIESEL PLANT:-

A. TRANSESTERIFICATION	Alkali Catalyzed - Highest rate of conversion as compared to acid esterification & enzymatic process
B. FAME WASHING & DRYING	After conversion to FAME, washing soap traces, removal of residual Methanol and then drying under high vacuum
C. METHANOL RECTIFICATION	Unreacted Methanol combined with water is distilled / rectified and recycled back to process
D. FAME DISTILLATION	In FAME distillation purity achieved up to 99.5%
E. GLYCERINE TREATMENT	Crude glycerine released after reaction get mixed with water as heavier phase with traces of soap is treated with dilute acid and dried to bring level up to 40% , which further can be distilled to recycle back for Glycerolysis to treat high FFA feed stocks

NEAR NEUTRAL CLEAN FEED STOCK FLOW SCHEME – ALKALI CATALYSED



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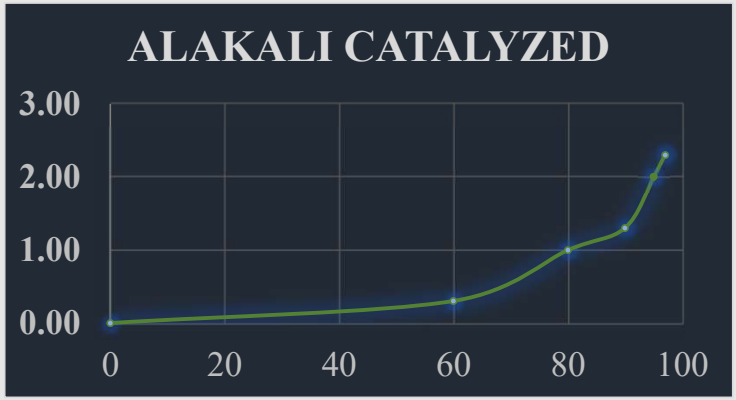
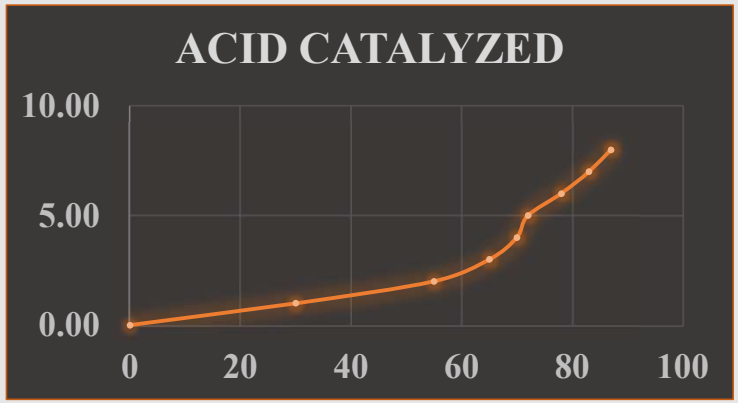
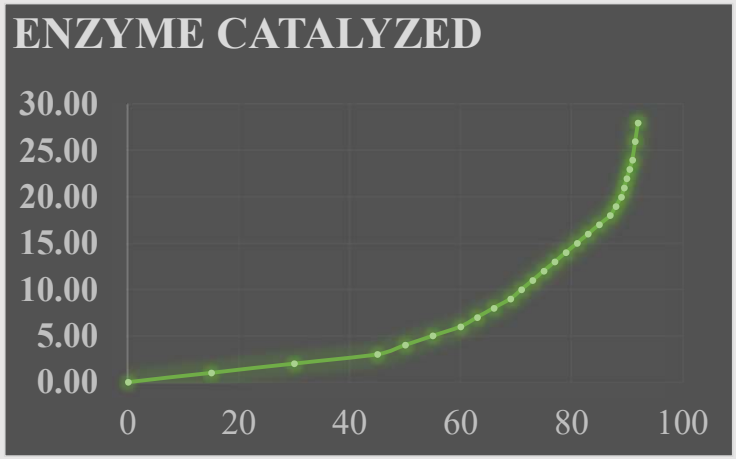
COMPARISON OF DIFFERENT TRANSESTERIFICATION PROCESSES

ALKALI CALAYZED	ACID CATALYZED	ENZYME CATALYZED
Conversion up to 96 - 97%	Conversion up to 87 - 87%	Conversion up to 92%
Methanol required : 20%	Methanol required : 35%	Methanol required : 25%
Catalyst required: < 0.6%	Catalyst required:0.8 - 1%	Catalyst required:0.2-0.3%
Reaction Time :2 hrs.	Reaction Time:8 hrs.	Reaction Time: 26 - 32 hrs
Alkali catalyzed rout required near neutral feedstock	Recommended for high FFA Feed-stocks	Work for both neutral as well as high FFA fee-stock but conversion level has limitations

GRAPH ICAL REPRESENTATION FOR TRANSESTERIFICATION PROCESS WITH DIFFERENT ROUTES:- (Reaction Time Vs. % Conversion)







CASE STUDY : 150 TPD MULTI-FEEDSTOCK BIODIESEL PLANT SUPPLIED BY DVC :-

FEEDSROCK PROCESSED	(Multi-feedstock)Tallow, Acid oil, Palm stearin, Used cooking oil, Fatty Acid distillate etc
SECTIONS INCLUDED IN PRETREATMEMNT	Washing, Bleaching, Glycerolysis & Deacidification.
SECTIONS INCLUDED IN BIODIESEL PRODUCTION	Alkali catalyzed Transesterification, FAME Washing & Drying, FAME Distillation
QUALITY OF PRODUCT	IS 15607: 2022

UTILTITY CONSUMPTION : PRETREATMENT

Sr. No.	Parameter	Unit	Washing (acid oil)	Bleach.	Glycerol -ysis	Deacidfication
A.	Utilities					
1.	Feed Oil / product temperature	0C	40	70	60	100
2.	Steam					
	Steam for heating in startup state	kg/T	45	25	55	NA
	Steam for heating in steady state	kg/T	32	0	55	0
	Live steam	kg/T	-	-	-	8
	Steam for vacuum (9 bar)	kg/T	16	18	180	95
	Steam For Filter Blowing	kg/T		10	-	-
	Steam for Tracing	kg/T	5	5	5	5
	Total steam(Start-up)	Kg/T	66	58	200	NA
	Total steam(steady state)	**kg/T**	**53**	**33**	**200**	**108**
3.	Fuel (coal with GCV 3500 kcal/kg)	kg/T	-	-	36	23
4.	Installed power in process house(Indicative)	kW	42	35	35	25
5.	Installed Power for common Thermal oil Heater(Indicative)	kW	-	-	30	
6.	Power Consumption(Indicative)	kWH / T	5.4	4.5	4.5	3.2 +3.9(TFH)
7.	Contaminated water in circulation	m3/hr	-	24	64	100
8.	Clean water in circulation	m3/hr	-	-	45	90
9.	Process soft / RO water	m3/T	0.1	-	-	-
10.	Air at 6 bar					
	for instruments	Nm3/hr	3	3	3	3
	For Filter	Nm3/min	-	6	-	-
A	**Chemicals**					
11	Sodium Carbonate(for acid oil)	Kg/T	2 - 3	-	-	-
12	Phosphoric Acid (85%)	Kg/T	NA	1-1.5	**NA**	**NA**
13	Bleaching Earth	Kg/T	-	25 -30	-	-
14	Refined Glycerin (Purity >98%) (Considering PFAD of 100% FFA)	Kg/T	-	-	110	-

UTILTITY CONSUMPTION : BIODIESEL PRODUCTION

Sr. No.	Parameter	Unit	Transesterification	FAME Disti.	Meth. Recti.
A	Utilities				
11.	Feed Oil / product temperature	0C	60	50	50
12	Steam				
	Steam for heating (Start Up)	Kg/T	255	15	250
	Steam for heating (steady State)	Kg/T	240	-	250
	Live steam	Kg/T	-	-	-
	Steam for vacuum	Kg/T	65	40	-
	Steam for Tracing	Kg/T	5	5	-
	Total steam	kg/T	310	45	250
13.	Fuel (coal with GCV 3500 kcal/kg)	kg/T	-	38	
14.	Installed power in process house (Indicative)	kW	129	22	22
15.	Power Consumption (Indicative)	kWH / T	16.5	2.8	11.2
16.	Contaminated water in circulation	m3/hr	-	30	-
17.	Clean water in circulation	m3/hr	70	160	110
18.	Chilled water in circulation	m3/h	-	-	8
19.	Process soft / RO water	m3/T	0.08	-	
20.	Air at 6 bar				
	for instruments	Nm3/hr	2	2	2
B	Chemicals				
21	Methanol (Purity-99.8%)	Kg/T	130	-	-
22	Catalyst (Sodium Methoxide on 100% Basis)	Kg/T	7		
23	Citric acid dry	Kg/T	0.7	-	-
24	Hydrochloric Acid	Kg/T	20	-	-
25	Sodium Hydroxide Lye (40% Conce.)	Kg/T	15	-	-

ADVANTAGES OF DVC'S BIODIESEL PLANT

- Proven technology for handling variable feedstock.
- Optimum utility consumption.
- Meeting Biodiesel BIS / European standards B100.
- Chemical consumption is lower comparatively
- Glycerin processing to get additional glycerin.
- Higher efficiency due to process automation by PLC using SCADA
- Lower maintenance with ease for
- Systems are user friendly

BIODIESEL OBTAINED AFTER PRETREATMENT & TRANSESTERIFICATION :-

WASHED & DRIED FAME

DISTILLED BIODIESEL

OIL TECHNOLOGISTS ASSOCIATION OF INDIA - WZ & DVC

WELCOMES YOU TO

FOIC2025

FATS & OILS INTERNATIONAL CONFERENCE - EXHIBITION 2025

6 - 8 MARCH, 2025 JW MARRIOTT SAHAR, MUMBAI

"TECHNOLOGICAL INNOVATIONS, EFFICIENCY & VALUE ADDITION FOLLOWING PRINCIPLES OF GREEN CHEMISTRY!!"

Technology with innovation

Thank You!

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