

Summary of Outcome of R&D Projects Ministry of New and Renewable Energy, New Delhi

- 1.0 Project Title** : **Integrated Technology Development for Biodiesel Production using Heterogeneous Catalyst**
- 2.0 Project sanction no. & date** : F.No. 7/144/2009-NT dated 01.10.2010
- 3.0 Project time frame** : October, 2010 – Aug.2013
- 4.0 Executing Institution** : Sardar Swaran Singh National Institute of Renewable Energy, Kapurthala , Punjab -144601
- 5.0 Project Outlay** : Rs.60.29 Lacs
- 6.0 Key Objective** :

To develop heterogeneous catalyst for tranesterification of non-edible oils using both methanol/ ethanol for biodiesel production in order to get maximum conversion efficacy.

7.0 Project Outcome :

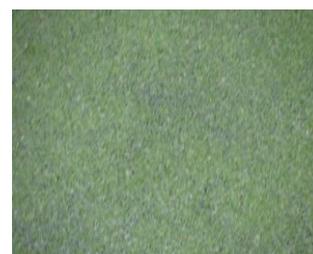
Development of two waste material based heterogeneous catalysts for production of biodiesel and optimization of a process to improve the yield of biodiesel from *Jatropha curcas* oil (JCO) using identified heterogeneous catalyst.

8.0 Significant achievements summarizing technology development and commercialization :

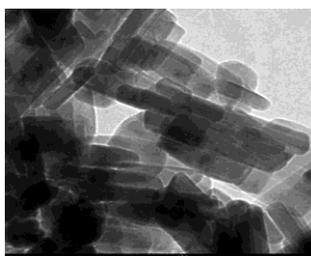
- Identification of two green catalysts, *Lemna perpusilla* Torrey (An aquatic plant) and *Musa balbisiana* Colla underground stem (MBCUS: a seed containing banana tree) ash as mixed character catalysts (hybrid homogeneous and heterogeneous nature) for tranesterification (i.e. biodiesel production) having mixtures of several metal and non-metal oxides in their composition.
- Reactivity and reusability of MBCUS catalyst was found very effective for conversion of low-grade (having 9-10% free fatty acids) *Jatropha* and *Mesua ferrea* L oil into biodiesel at relatively high temperature due to its nano crystalline nature , high percentage of potassium oxide, versatile composition and high surface area.



Musa Balbisiana Colla underground stem, ash @550°C



Lemna Perpusilla Torrey plants



SEM Image of MBCUS



Jatropha curcas L plants and fruits

- The presently developed single batch biodiesel production process i.e. conversion of high FFA containing JCO using 5% MBCUS catalyst at 275°C , with 1:9 mol/mol oil to alcohol ratio within 1h reaction, is a very effective process especially to produce biodiesel confined to ASTM/BIS standards. Earlier reported tedious two step tranesterification process works generally in two steps: esterification using acid catalyst followed by tranesterification using alkali catalyst which can be avoided. Moreover, with the application of the MBCUS catalyst the supercritical conditions of tranesterification are also not required.

9.0 S & T benefits

Publications

International

1. Chouhan, APS, Sarma, AK. Biodiesel production from *Jatropha curcas* L.oil using *Lemna Perpusilla* Torrey ash as heterogenous catalyst, Biomass and Bioenergy 55(2013) 386 -389. [JIP= 3.67]
2. Chouhan, APS, Sarma, AK. A comparative analysis of kinetic parameters from TGDTA of *Jatropha curcas* oil, biodiesel, petroleum diesel and B50 using different methods, Fuel109 (2013) 217–224. [JIP= 3.24]
3. Chouhan, APS, Sarma, AK. Modern Heterogeneous catalysts for biodiesel production- a comprehensive review. Renewable and Sustainable Energy Reviews, 15 (2011) 4378– 4399 [JIP= 4.56]

Papers submitted

1. A.K.Sarma, Prashant Kumar, Mohammad Aslam, A.P. Singh Chouhan, Preparation and characterization of a new nano-material for biodiesel production under levated condition (Submitted to **Catalysis letters**).
2. Neetu Singh, Mohammad Aslam, M K Jha, Y.K. Yadav, A K Sarma, Performance, combustion and emission analysis of fatty acid ethyl ester and its blends with petroleum diesel in CI engine (Submitted to **Fuel**).

Technologies/processes transferred with firm/agency name, if any : under consideration

Human Resource Development, if any

No. of Ph.Ds : Two (Ongoing)

No. of Man power trained : Two (One post doc, one M.Tech)

10.0 Future direction for Research:

Short term goals (next two years)

- Evaluation of both methanolysis and ethanolysis using identified heterogenous catalyst, 5 wt. %, MBCUS at high temperature and pressure for biodiesel production from oils having high free fatty acid content.
- Demonstration of the presently developed single batch transesterification technology on pilot scale using heterogenous catalysts and comparison with the conventional processes using homogenous catalysts.

Long term goals (Next five years)

- Commercialisation of the two developed catalysts MBCUS in particular due its easy availability and high efficacy during tranesterification in those regions where they are easily accessible along with availability of low grade high free fatty acid containing oils such as *Jatropha*, *Karanja* and *Mesua ferrea* etc.
- Development of complete technology from tranesterification to glycerol purification for the production of biodiesel.
- Scaling up the process for industrial application particularly for the regions where the reactants and catalyst can be made available at low cost.
- Utilization of these catalysts for some other purposes such as hydroprocessing of non-edible vegetable oil to produce biocrude and green diesel.

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