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Direct and Indirect Applications of Nanotechnology in Biomass Energy Production in Algeria

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ABSTRACT

70% of renewable energy will be included in Algeria energy mix in 2030. The target of renewable energy plan on solar, wind, geothermic and biomass is to replace the fossil fuel. The Algeria biomass energy potential is formed by solid wastes, date palm, crop wastes and forestry residues. Integration of renewable energy into agricultural sector is necessary because the rural areas need biomass for cooking and lighting. 238 million hectares of Algerian grazing lands are neglected that can be used for energy purposes. There are different technologies to convert biomass to renewable energy but the contribution of nanotechnology is limited. This study reports direct and indirect applications of nanotechnology in the production of bioenergy and the technical problems that tackle this energy to compete with fossil fuels.

Keywords: biomass, nanotechnology, agriculture, Algeria

1. Introduction

Bio-based products hold great potential to resolve the current energy and environmental crises. So, the development of advanced conversion technologies suitable for different types of biomass is likely to make bio-based products (energy and materials) competitive with petroleum based products. Despite the diversity of products obtained from biomass and the large number of processes. But limitations arise during production or during use.

2. Applications of nanotechnology

Application of nanotechnology consists in use of the new properties and functionalities at nano scale for the improvement of existing products or the development of new products.

Nanotechnologies contribute to:

- The optimization of energetic biomass utilization, for example in the development of new conversion methods (catalysts, process technology and sensors')
- The nano-optimized cultivation of bio-resources (e.g. efficient utilization of fertilizers and pesticides through nano-encapsulation and nano-sensors);

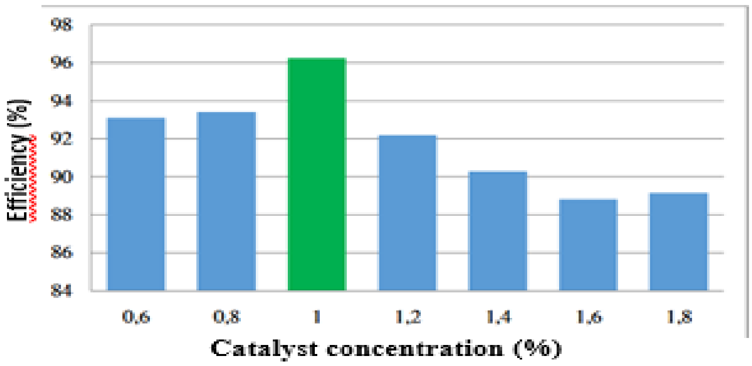

Figure 1: Effect of catalyst quantity on trans-esterification.

- **Application of catalytic in transesterification**

Trans-esterification of a vegetable oil with an alcohol were carried out with soybean oil and butanol at 117°C, using an alcohol/oil molar ratio equal to 30 shows that kinetic constants were determined in the

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case of acid catalysis with 1% H_2SO_4. In the case of a base catalysis, 0.5 and 1% sodium butoxide (NaOBu) should be used (fig.1.). The Table 1 presents the results in the case of catalyses, acid and base [1-2]. The use of nano-catalysts for the trans-esterification of fatty esters from vegetable oils or animal fats into biodiesel and glycerol consists on the nano-catalyst spheres (figure6) replace the commonly used sodium methoxide. The spheres are loaded with acidic catalysts to react with the free fatty acids and basic catalysts to react with the oils. This approach eliminates several production steps of the conventional process, including acid neutralization, water washes and separations. All those steps dissolve the sodium methoxide catalyst so it can't be used again. In contrast, the catalytic nanospheres can be recovered and recycled. The overall result is a cheaper, simpler and leaner process. As shown in table 2 [3], the best efficiency of the reaction is obtained by using methanol as alcohol; this is due to its great reactivity, its solvent power, its low steric hindrance and its higher acid character compared to the others linear or branched alcohols used.

Table1: *Effect of Catalyst on Rate Constant Values*

	Rate constant. 10^3			Activation energy (cal.mol-1)		
Reactions	1% H_2SO_4 77°C	1% NaOBu 60°C	0.5% NaOBu 60°C	1% H_2SO_4 77-117°C	1% NaOBu 20-60°C	0.5% NaOBu 20-60°C
Triglyceride-diglyceride	3	3822	26626	14922	15360	15662
Diglyceride-monoglyceride	8	1215	3584	16435	11199	13053
Monoglyceride-glycerol	7	792	2373	15067	11621	13395
Diglyceride-triglyceride	0.02	121	439	19895	17195	15587
Monoglyceride-diglyceride	0.05	7	8	16885	-	13336
Glycerol-monoglyceride	0.03	11	7	12196	-	13110

- **Application of catalytic in biodiesel production**

Table 2 shows that biodiesel yield increase with catalyst amount and type for reaction time and temperature.

Table 2: Effect of nanocatalysts on biodiesel yield [19].

Nanocatalyst	Mode of synthesis	Feedstock	Catalyst amount %	Reaction time (h) and reaction temperature (°C)	Biodiesel yield %
Na_2O/CNT	Impregnation method	Used cooking oil	3	3/65	97
Sulfonated biochar and activated carbon	Pyrolysis method	Vegetable oil	2 - 8	6/55 - 60	97

- **Indirect applications of nanotechnology in biomass process**

Use nano particles as a machine to extract oils from algae directly without subjecting them to physical process.

3. Conclusion

Biomass energy is often the only accessible and affordable source of energy in rural areas. The availability and wide diversity of biomass resources in Algeria have made them an attractive and promising source of energy. But, it has limitations and there are some challenges in presenting them economically more viable. So, it is important to use nanoscience and nanotechnology in the development of biomass energy production schemes in form of nanocatalytics.

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