

Production of Biodiesel from Wastewater Sludge Treatment by Direct Lipids Extraction

Muhammad Usman*

Department of Chemical Engineering and Technology, University of Gujrat, Gujrat, Pakistan

Abstract

Biodiesel is outstanding amongst other elective fuel to the non-renewable energy sources which are non-renewable and will be run out in coming future. Because of an Earth-wide temperature boost and appeal of vitality we should move towards sustainable assets. Biodiesel production from wastewater sludge treatment by extracting the lipids are economically feasible because it has high contents of lipids feedstock with high yield of oil and negligible cost on feedstock. 49.4 ton for every hour biodiesel can be create from daily generation of wastewater of Lahore area in Pakistan. In this exploration we separate the triglycerides from the wastewater slime by coordinate technique through this we will ready to lessen the immense measure of city squander in to the helpful products which will secure our condition and a worldwide temperature alteration. Civil wastewater muck contains the assortment of natural mixes and inorganic mixes. Additionally, it predominantly contains proteins, lipids, sugar, and cleansers. The oil yield from wastewater muck treatment is exceptionally more prominent than alternate sources like soybean oil, microbiological, green growth and so forth as per the distinctive nations examine the lipids extraction from wastewater sludge treatment is around 0.03\$ for every gallon which is lower than different assets of feedstock for biodiesel.

Keywords: Biodiesel; Waste water; Sludge; Waste management

Introduction

The vitality emergency makes because of the increments of industrialization and urbanization. They request the more vitality which is satisfied by the non-renewable energy sources which are non-renewable and will be run out in the coming future. That is the reason we confront the emergency of vitality in everywhere throughout the world since high measure of fossils energizes is use in our necessity. We can control it through economic advancement by utilizing sustainable natural cordial vitality in our nation and even everywhere throughout the world. As indicated by the International Energy Agency, (Figure 1) the world will require 37% more vitality in 2040 than today [1].

There are numerous elective powers like biogas, bioethanol however biodiesel is a standout amongst the most essential elective fuel to the non-renewable energy sources. We can deliver it from sunflower, soybean, coconut, palm and jatropa (Table 1) which isn't temperate and now we should move to that materials which have exceptionally substance of oils like city wastewater slime [1,2]. City sewage slime has a high measure of lipids feedstock which is extremely valuable to

deliver biodiesel [1,3-5]. What's more, the second alluring thing from metropolitan waste water slop is it delivers in vast sum and practical because our crude material is close going to free. In Pakistan it is the most essential issue how to defeat the wastewater which is delivered in expansive sum. With this thought we can regard the wastewater and their ooze which we regularly squander in our territories [6]. Through this perhaps we will ready to control the metropolitan waste and secure our condition. In Pakistan we have such huge numbers of assets to control the vitality utilization and in addition their generation as indicated by our requests. Municipal wastewater slime has numerous natural and inorganic segments which are recoverable [1,7]. Besides, it contains the household, mechanical, doctor's facility and agribusiness wastewater. We can remove the 99% lipids feedstock from wastewater muck however for this we require the more research work and great innovation [8]. On the off chance that I attempt to include the wastewater creation Pakistan or even a solitary city of Pakistan it has

Biomass	Oil content (dry basis) (%)	Oil yield (dry basis) (g m ⁻² day ⁻¹)
Sewage sludge	18-20	1290
Microalgae	20-30	20
Palm	36	3.9
Rapeseed	42	0.65
Jatropa	28	0.67
Sunflower	40	0.47
Soybean	18-20	0.59

Table 1: All assumptions used for analysis.

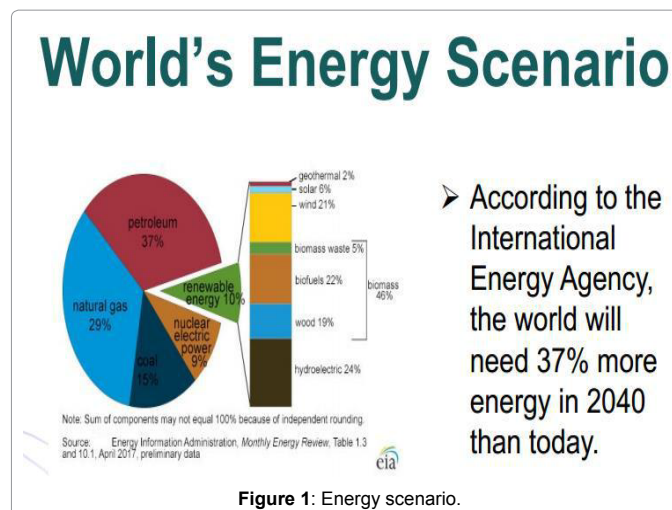


Figure 1: Energy scenario.

*Corresponding author: Muhammad Usman, Department of Chemical Engineering and Technology, University of Gujrat, Gujrat, Punjab 50700, Pakistan, Tel: +92 53 3643112; E-mail: Umuhammad185@gmail.com

Received April 19, 2017; Accepted May 15, 2018; Published May 22, 2018

Citation: Usman M (2018) Production of Biodiesel from Wastewater Sludge Treatment by Direct Lipids Extraction. J Fundam Renewable Energy Appl 8: 261. doi:10.4172/20904541.1000261

Copyright: © 2018 Usman M. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

in huge sum like mega litres. Our enormous urban areas like Lahore, Karachi, Multan, etc. create high measure of wastewater as indicated by their populaces [3,6]. This strategy and crude material is one the least expensive which can satisfy our requests of vitality. Since this biofuel can be used in vitality division to run the creation plant. We can utilize it in our vehicle immediate or circuitous [5,7].

Biodiesel is a standout amongst the most vital and promising fills in the elective powers to decrease the utilization of the fossils energizes. In everywhere throughout the world individuals are attempting to change over their activities from fossils powers to elective powers like biogas, biodiesel and so on. Presently a day's biodiesel is the most vital fuel which creates from creature fats, vegetables and our squanders [7]. In Pakistan, which is the created nation and face the numerous issue to deliver the vitality as indicated by utilization. It is profoundly required in Pakistan to create biodiesel from waste and utilize it in vitality areas [3]. A few nations are attempting to enhance this creation yet they all are utilizing the dry technique which is extremely sparing. Yet, we can create it through other technique which is immediate lipids extraction from wastewater slime this strategy is a savvy [8].

Materials and Methods

There is huge measure of wastewater create in even a solitary city because of the industrialization and overpopulation. Since it is the basic require for everybody in our industry and our residential purposes. As indicated by the examination slop substance in wastewater is close going to 140-160 mg/l. In Pakistan the waste water creation as per the 2005 report (Table 2). In Pakistan their wastewater generation sum every year by urban communities [3].

The extraction of lipids from wastewater muck is the most imperative factor in our everything thought [9,10]. The primary strategy which is utilized as a part of our examination that was the dry technique [2,5,11] which comprise of following advances:

- Sewage sludge: Is a semi strong material which is build up in the wastewater treatment.
- Filtration: Partition method is utilized to isolate the other waste in slime like paper, wood and so on.
- Drying: Process used to think and setting the discharge.
- Strong fluid extraction: This additionally a partition strategy which is utilized to isolate the fundamental product lipids from strong with the assistance of dissolvable like Hexane.
- Transesterification: Is a response of triglycerides with liquor which creates biodiesel and glycerol.
- Separation: With the assistance of refining segment we isolate the biodiesel from glycerol in view of breaking point or greater instability.

City	Wastewater production 10 ⁶ m ³ /y
Lahore	287
Faisalabad	129
Gujranwala	71
Rawalpindi	40
Sheikhupura	15
Multan	66
Sialkot	19
Karachi	604

Table 2: Wastewater production from different cities of Pakistan.

- Products: Last after effects of process which is biodiesel.

There are diverse kinds of metropolitan wastewater slime (essential, auxiliary, settled). In essential civil wastewater slime has the high substance of lipids instead of other. The lipids are separated by utilizing hexane in an extractor and change it into the biodiesel by transesterification. Yet, for this we needed to change the semi strong muck into the dry ooze which is generally costly [2,4,11,12].

Straightforward stream graph of dry strategy is shown in Figure 2. In which you can see that we should dry and hardening the slop which costlier and it is a major test to conquer these issues [3,13].

In any case, now we have another strategy to expel the lipids in prudent courses by coordinate lipids extraction by utilizing hexane dissolvable in a blender pioneer and can change over it in our required products biodiesel. In this technique we won't have to apply the drying of slop and we can spare the vitality which make it temperate and financially savvy [4,11-13].

- Sewage sludge: Semi strong material which is delivers when we treat the wastewater.
- Coordinate lipid extraction: In this strategy we will remove the lipids from wastewater slop without dry the slime.
- Transesterification: The response of triglycerides with the liquor in which lipids change into biodiesel and glycerol.
- Detachment: To isolate the primary product biodiesel from glycerol in refining section.
- Products: Biodiesel and glycerol.

The procedure is shown in Figure 3 demonstrating the wastewater treatment and slime treatment by coordinate lipids extraction in this technique we needn't bother with the drying of slop.

After the accumulation of wastewater and oxygen consuming treatment of wastewater we got the wastewater slop from where we separate the lipids content with the assistance of hexane and lipids than respond with methanol within the sight of sulphuric acid which is utilized as an impetus. After the response of reactant, we isolate the items which are glycerol and biodiesel with the assistance of thickness contrast. Glycerol is a side-effect which is utilized as a part of essentially nourishment industry for sweating the sustenance [4,5,9,14].

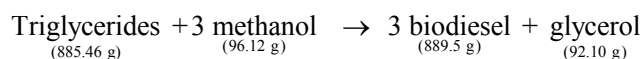
Process available for transesterification

There are three procedures accessible which are given underneath:

- Enzymes-catalyzed
- Base-catalyzed
- Acid-catalyzed

All procedures are same yet the component which may shift that is mechanism, product quality, cost, site product generation. In this research we are using acid-catalyzed transesterification because of some advantages on other process like, catalyst recovery, no soap formation, fast reaction etc.

Reaction and calculations



In this reaction we obtain the two products biodiesel which is

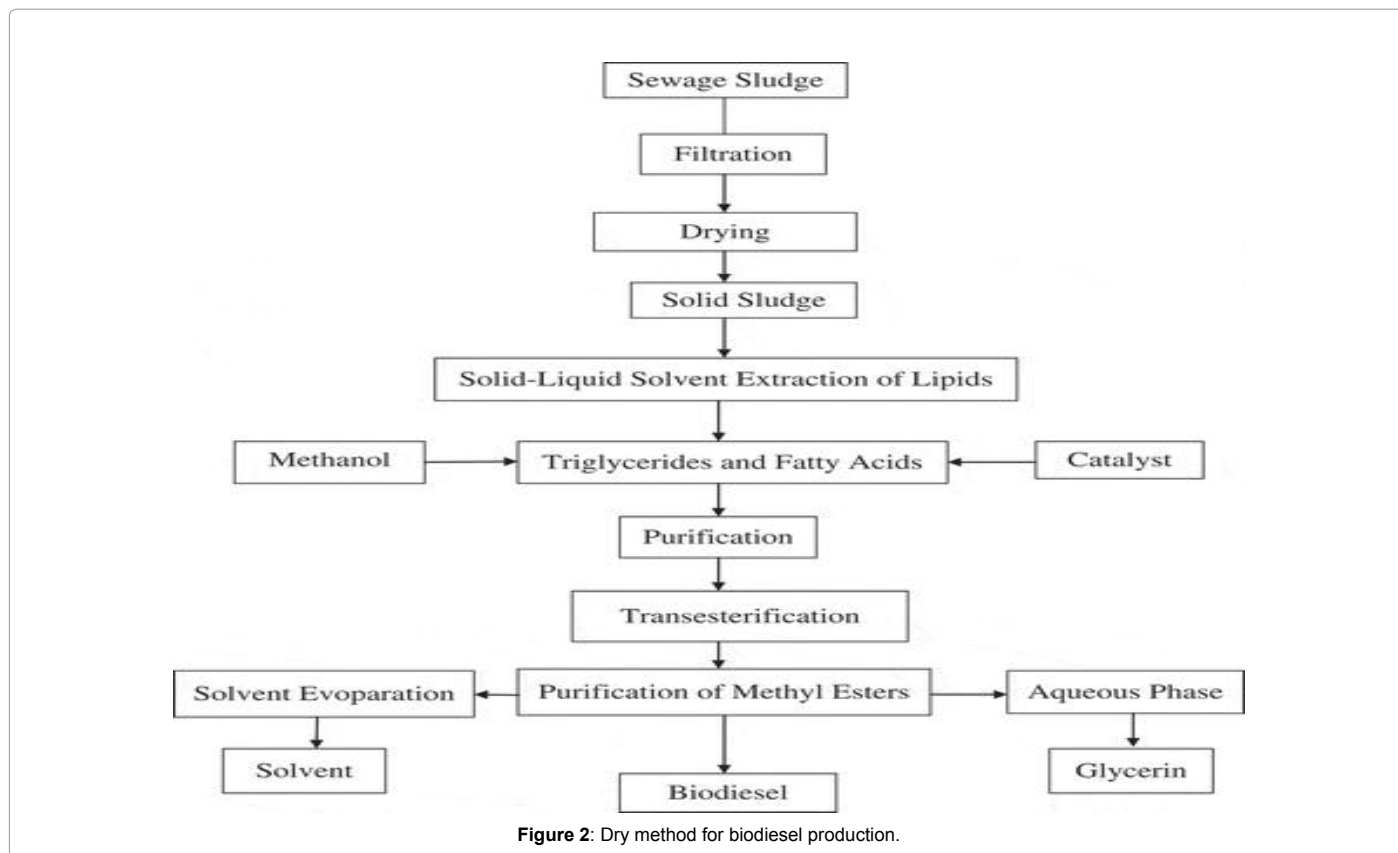


Figure 2: Dry method for biodiesel production.

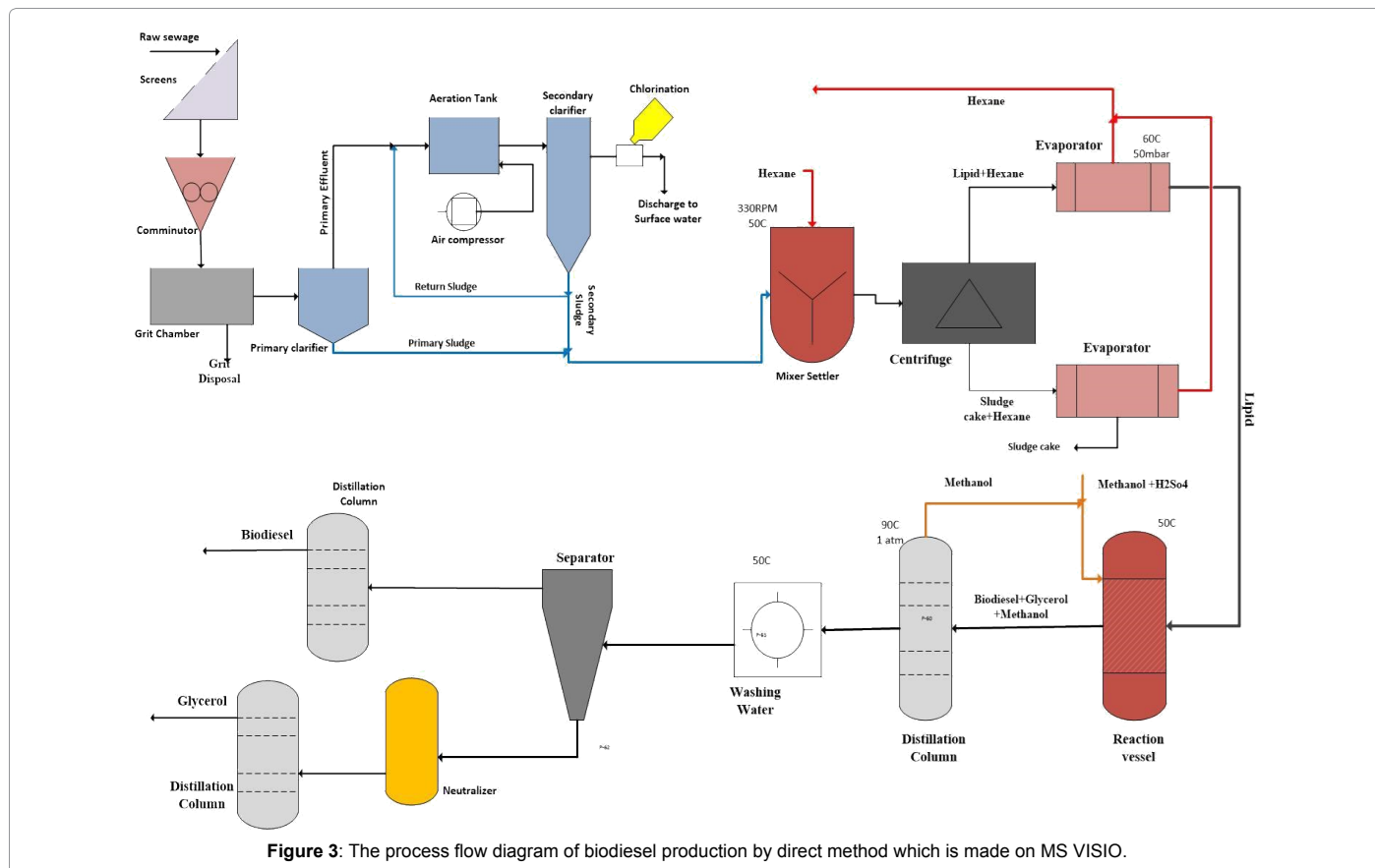


Figure 3: The process flow diagram of biodiesel production by direct method which is made on MS VISIO.

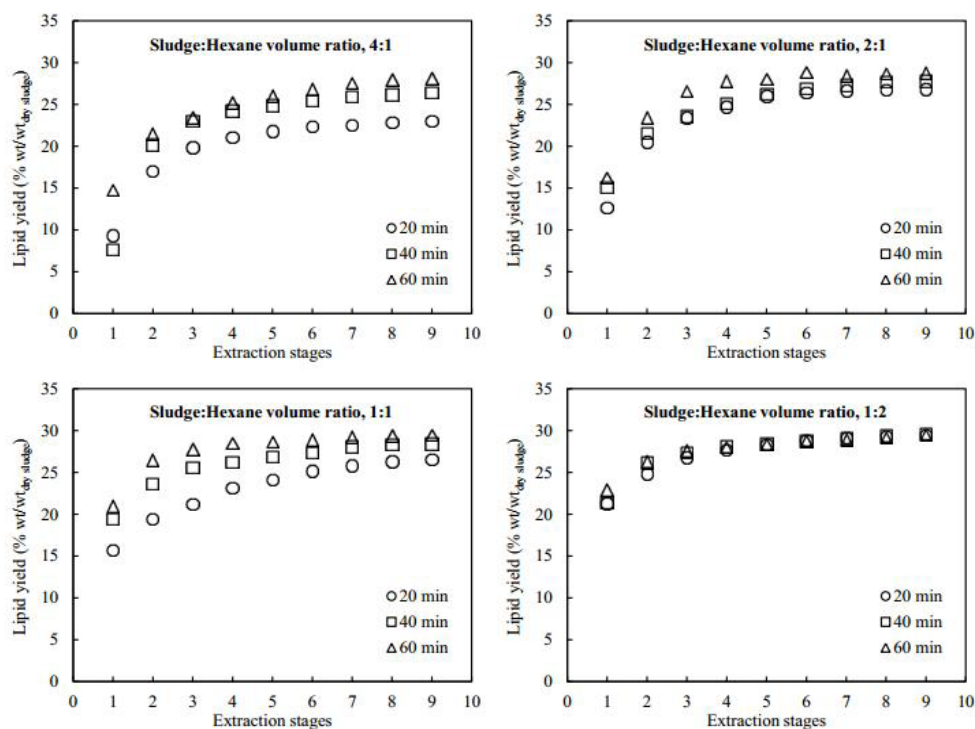


Figure 4: Effect of EXTRACTION time on the lipids yields with different sludge to hexane volume ratio.

named as fatty acids methyl esters (FAMES) and the glycerol. If we just discuss about the single city Lahore of Pakistan. In Table 3 it has the very amount of waste water in the Mega litre per year.

1 ml=140-160 kg sludge

1 ml=140-160 kg sludge

$117945 \times (0.28) = 37$ kg triglycerides/day

In wastewater sludge the composition consists of 35% Grease (triglycerides 28%, Free fatty acid 7%)

Now

$117945 \times (0.28) = 37$ kg triglycerides/day

If we take assumption 99% conversion of triglycerides in biodiesel then,

$30m^3 / day = 8981$ gallon/day or 49.5 ton per hour biodiesel production is possible.

Results, Discussion and Conclusion

Biodiesel creation from wastewater muck treatment by coordinate lipids extraction would be the immense chance to deliver the elective energizes to the traditional powers (Table 4). The following are results of components in wastewater sludge [9,12,14].

By dry technique and direct lipids strategy it demonstrates the insignificant variety in a basic decimal. In the wastewater slop has the high substance of glycerides and unsaturated fats. It would be the advantageous to deliver the biodiesel [11]. Relatively same measure of biodiesel produces from the two techniques; however, sparing is the one which is immediate lipids extraction. On the off chance that we

Components	Total sludge %
Hemicellulose	1.5
Cellulose	19.3
Lignin	8.2
Ash	22
Water	0.8
Amino Acids	13.2
Grease (Tryglycerides+Fatty acid)	35
Total	100

Table 3: The composition of wastewater sludge.

Sludge type	Experiment type	TS (%)	VS (%)	Lipid ^a (%)
Primary ^b	Sludge drying	3.9 ± 0.1	2.9 ± 0.1	26.3 ± 0.5
Primary ^c	Liquid-liquid extraction	3.4 ± 0.1	2.7 ± 0.1	25.2 ± 0.2
Secondary ^c	Liquid-liquid extraction	3.8 ± 0.1	3.2 ± 0.1	7.7 ± 0.1
Blended ^c	Liquid-liquid extraction	3.5 ± 0.1	2.7 ± 0.1	21.1 ± 0.2

a - Extraction according to standard $M_9SO_4 \cdot H_2O$ method, lipid yield on the basis of dry sludge

b - Lipid extracted from non-acidified sludge

c - Lipid extracted from acidified sludge

Values are mean ± SD, n=3

Table 4: Characteristic of wastewater sludge in different experiment work.

analyse between coordinate technique and dry strategy (Table 5) there is minor contrast in level of yield i.e., 19.8% by coordinate strategy and 21.2% by dry strategy [4].

With the help of this method and the raw material viability in the high amount we can produce a very large amount of biodiesel from a

Lipids	Lipids Yield (%)	
	Direct method	Dry method
	19.8	21.2

Table 5: Lipids yields by direct and dry methods.

single city of Pakistan is near about to 8500 gallons per day or 49.5 ton per hour which is a very huge amount of biodiesel and can be used in the energy sector to produce electricity. Through this we will be able to control the wastewater treatment their waste which will help us to protect our people as well our environment [15].

Direct liquid-liquid extraction of lipids from wastewater sludge for the biodiesel production with the hexane solvent on different time several results are shown in Figure 4.

From the above results highest percentage of lipids yields obtained at the 60 min, 28.15%, 28.79%, and 29.1% respectively. Overall If we want to improve it up to greater than 90% we will need the three consecutive extraction stages at the 60 min with the sludge to hexane ration 2:1, 1:2,1:1.

The production of biodiesel from wastewater sludge treatment will be cost effective if it would be run on continuous operation. Therefore, we will need the batch process for scaling up this production.

References

1. Kargbo DM (2010) Biodiesel production from municipal sewage sludge. Energy Fuel 24: 2791-2794.
2. Srivastava A, Prasad R (2000) Triglycerides-based diesel fuels. Renew Sust Energ Rev 4: 111-133.
3. Vaqar Z (2005) Water and Environmental Sustainability, Country Water Resources Assistance Strategy.
4. Olkiewicz M, Caporgno MP, Fortuny A, Stüber F, Fabregat A, et al. (2014) Direct liquid-liquid extraction of lipid from municipal sewage sludge for biodiesel production. Fuel Process Technol 128: 331-338.
5. Olkiewicz M, Fortuny A, Stüber F, Fabregat A, Font J, et al. (2012) Evaluation of different sludges from WWTP as a potential source for biodiesel production. Procedia Eng 42: 695-706.
6. Anonymous (2011) Overall water availability. Government of Pakistan, Ministry of Economic Affairs and Statistics. Pakistan Statistical Year Book.
7. Willson RM, Wiesman Z, Brenner A (2010) Analysing alternative bio-waste feedstock's for potential biodiesel production using time domain (TD)-NMR. Waste Management 30: 1881-1888.
8. Siddiquee MN, Rohani S (2011) Experimental analysis of lipid extraction and biodiesel production from wastewater sludge. Fuel Processing Technology 92: 2241-2251.
9. Revellame E, Hernandez R, French W, Holmes W, Alley E (2010) Biodiesel from activated sludge through in situ transesterification. J Chem Technol Biotechnol 85: 614-620.
10. Mondala A, Liang K, Toghiani H, Hernandez R, French T (2009) Biodiesel production by *in situ* transesterification of municipal primary and secondary sludge. Bioresour Technol 100: 1203-1210.
11. Zhu F, Zhao L, Zhang Z, Jiang H (2012) Preliminary study at lipids extraction technology from municipal sludge by organic solvent. Procedia Environ Sci 16: 352-356.
12. Bing L, Qingmei Y, Hua Z, Lei S, Youcai Z (2004) Methods of sludge treatment and disposal and resource utilization. Safety and Environmental Engineering 11: 52-56.
13. Mishra S, Jyot J, Kuhad RC, Lal B (2001) *In situ* bioremediation potential of an oily sludge -degrading bacterial consortium. Curr Microbiol 43: 328-335.
14. Mazlova EA, Meshcheryakov SV (1999) Ecological characteristics of oil sludges. Chem Technol Fuels Oils 35: 49-53.
15. Kwon EE, Kim S, Jeon YJ, Yi H (2012) Biodiesel production from sewage sludge: New paradigm for mining energy from municipal hazardous material. Environ Sci Technol 46: 10222-10228.