

# Effective Utilization of Sewage Sludge for Production of Energy

Vinayak B. Kale<sup>1</sup>, Vishvbramhe Aashirvad<sup>2</sup>, Rathod Saikumar<sup>3</sup>, Nikumbh Chetan<sup>4</sup>,  
Bhere Rameshwar<sup>5</sup>, Rasgotra Saahil Sharma<sup>6</sup>

<sup>1</sup>Assistant Professor, Department of Civil Engineering, Dr. D. Y. Patil Institute of Technology Pimpri, Pune-18, Maharashtra, India

<sup>2</sup> Under Graduate Scholar, Department of Civil Engineering, Dr. D. Y. Patil Institute of Technology Pimpri, Pune-18, Maharashtra, India

\*\*\*

**Abstract** - One of the most successful attempts to protect environment is sustainable development, it is a tool by which we maintain a balance in consumption and production rate of resources. Non-renewable resources are limited to very high extent (on the verge of extension), hence forth we need to find alternate form of resources with comparable calorific value in terms of production of energy and with least negative impact on environment. One of such attempt is the utilization of sludge cakes. In country like India the combustion of biomass and waste materials together with coal in power plant is expected to find wide application in near future. Combustion experiments were carried out with various portions of thermally dried municipal sewage sludge. The by-products of combustion process were collected and balance.

**Key Words:** Environment, Sustainable, Non-renewable, Calorific value, Sludge cakes, coal, Combustion.

## 1. INTRODUCTION

Wastewater treatment gives rise to large quantities of runny sludge that contains a low proportion of solid matter. The water usually has to be drained from this sludge before it can be used, dumped in landfills or incinerated, and this is often accomplished via pressing. A solids content of approximately 20 percent can be achieved this way. In some countries this semisolid sludge is spread on fields as fertilizer or dumped in landfills. In some countries, however, a solids content of at least 60 percent is mandated for these purposes, and this was recently prescribed by law in China as well. In order to attain this high percentage of solid matter, the sludge must be dried. This can be accomplished very rapidly with thermal processes, which demand a great deal of energy. Alternatively, the sludge can be dried with help from the sun, but this can take up to two months.

The Pimpri Chinchwad city is vast in area which has population of around 17.29 lakhs as per Indian Sensors 2011. The sewage generation of this area is huge, according to environmental report of Pimpri Chinchwad 2012-13, the total sewage generation was 277.2 MLD. This amount of sludge creates lots of problems of disposal of treated sludge. This problem also leads to large air pollution in the form of foul gases and smells this situation is becoming severely worse and air quality decreasing day by day. This enlightens the attempt of focusing towards sustainable and reliable use of treated sewage sludge by making briquettes with coal powder using various mixing proportions.

### 1.1 Reasons behind selection of topic:

Now-a-days, pollution, especially Air pollution is major concern of every human being in India. Air pollution is increasing severely, majorly because of burning of conventional fuels like Coal, Wood, Petrol, Diesel, etc. The coal is major source for electricity generation in India. The coal is majorly consumed by Indian Govt. agencies like Thermal power generation plants, Indian Railways, etc. in addition to this, some private agencies also consumes it as their fuel. The globalization process in India is on the peak, so it needs electricity in large amount.

Along with Air Pollution, Land and Ground Water Pollution is also increasing rapidly because of increasing population of India. This is creating the severe problem of disposal of treated sewage sludge. It creates lots of problems like foul gases, smell, adulteration of soil and ground water.

So, this attempt will be a step towards the reduction of such pollution and tremendous use of coal by utilizing this sewage sludge effectively, provision of alternate fuel source for production of energy.

### 1.2 Needs of sewage sludge for thermal energy production:

2. The limited extent of natural energy source i.e. Coal shortage in mines.
3. Lack of coal in power plants (electricity) and for transportation systems.
4. Effective utilization of sewage sludge, i.e. direct disposal of sewage sludge on the open ground is reduced.
5. Sewage sludge is available in ample amount in abundance, so it can be effectively utilized.

### 1.3 Objectives:

This project aimed to research, analyze, design and implement methods of increasing sustainable energy production from sewage sludge. The project has been structured,

1. To identify the optimum use of coal for energy production.
2. To increase the use of waste sewage as a source of fuel.

3. To control and monitor the liberated gases (CO<sub>2</sub>, NO<sub>2</sub>, SO<sub>2</sub>, etc.) by effective adulteration of conventional fuel (Coal) with invented fuel (Sludge waste).

**1.4 Review Summary:**

After studying the recent problems of environment like treated sludge disposal, which creates a lot of problems to environment and society; reduced coal availability plus strict government rules and regulations about environmental concern; we understand the need of another resource for thermal power or alternative to non-renewable fuels like coal, coke or even wood. This is our approach to provide a good, sustainable energy source, that will help the environment and society to reduce pollution, also the government to get new energy source and it will reduce the cost of purchase/import the coal, coke, etc. That's why we choose effective utilization of sewage sludge briquettes for production of energy.

**2. SEWAGE SLUDGE**

**Table 1: Properties of Sludge**

Ingredients	Percentage Concentration
Biodegradable (Food Waste, Garden Waste)	74.7
Paper	15.9
Plastic	6.1
Textile	2.1
Glass and metals	0.7
Inert	0.5
Total	100

**Table 2: Properties of Cow dung**

Ingredients	Percentage Concentration
Nitrogen (%)	1.61
Phosphorus (%)	0.7
Potassium (%)	0.53
Magnesium (%)	0.91
Calcium (%)	2.71
Sodium (%)	0.50

**Table 3: Properties of Coal**

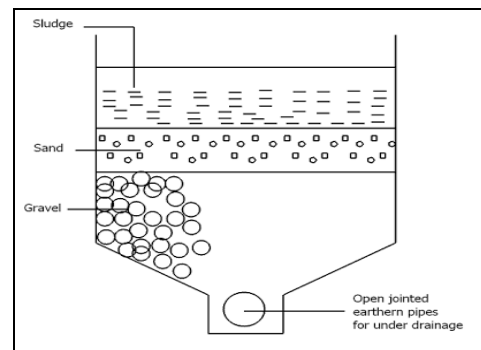
Ingredients	Percentage Concentration
Volatile	34.7
Ash	8.3
C	72.5
H	5.6
N	1.3
S	0.9
Cl	0.16
O	11.2

**2.1 Properties of dried sludge:**

- No harmful emissions are identified since sludge is used for agricultural purpose as natural fertilizer.
- But, testing of raw sewage is necessary before incinerating the sludge.
- Harmful emissions are found once the sludge is incinerated.

**2.2 Sludge dewatering:**

- Dewatering aims to reduce the water content further.
- The sludge can then be handled like a solids
- Dewatering can be done mechanically using a filter press (employing pressure or vacuum).
- Also be done by using drying beds.



**Fig -1: Sludge Drying Beds**

**2.3 Methodology:**

- Need of alternative energy source
- Survey for sewage sludge generation.
- Sample preparation
- Short listing the methods for testing
- Short listing the properties of sludge
- Testing of different samples
- Analysis of properties of samples

**3. RESEARCH PROGRAM**

**3.1 Description:**

From the previous chapters, we came to know about the concept of effective utilization of sewage sludge briquettes, this is the reason behind us have chosen this particular topic. There are some important parameters on which basic properties of coal/coke will be possibly identified. Using different parameters, an attempt will be made to test sewage sludge briquettes.

Even through, we can say that, the entire study and research program will enlighten the utilization of raw sewage waste for considerable energy production ability. This will unlock the new way towards the energy production by studying these parameters.

Under the 1<sup>st</sup> Phase of project, an attempt is made to identify, Need, Relevance, Objective of research program, Scope of work, Parameters and test program with respect to sewage and coal. Also the study of relevant code of practices used by government agencies like Indian Railways, Electricity Boards and other Government Institutions were identified. There is some Indian Standard (I.S.) the sewage briquettes will be verify according to these code of references to full fill the minimum criterion of energy production in compression with Coal.

**3.2 Problem statement:**

An attempt is made to analyze the sustainable use of treated sewage sludge in the form of briquettes and along with the varying mixtures of coal powder for production of eco-friendly alternatives energy source for societal benefits.

**3.2.1 Aim:**

- Effective utilization of sewage sludge.
- Study the quality of the fuel briquettes made from sewage sludge mixed with coal powder.
- Reduction in the consumption of conventional fuel.

**3.2.2 Objectives:**

This project aimed to research, analyze, design and implement methods of increasing sustainable energy production from sewage sludge. The project has been structured,

1. To identify the optimum use of coal for energy production.
2. To increase the use of waste sewage as a source of fuel.
3. To control and monitor the liberated gases (CO<sub>2</sub>, NO<sub>2</sub>, SO<sub>2</sub>) by effective adulteration of conventional fuel (Coal) with invented fuel (Sludge waste).

**3.3 Constituents:**

**A. Sewage Sludge:**

1. Organic Matter
2. Nitrogen
3. Phosphorus
4. Calcium
5. Magnesium
6. Lead
7. Zinc
8. Copper

**B. Coal:**

1. Carbon
2. Hydrogen
3. Sulfur
4. Oxygen
5. Nitrogen

**C. Cow dung:**

1. Nitrogen
2. Phosphorus
3. Potassium
4. Magnesium
5. Calcium
6. Sodium

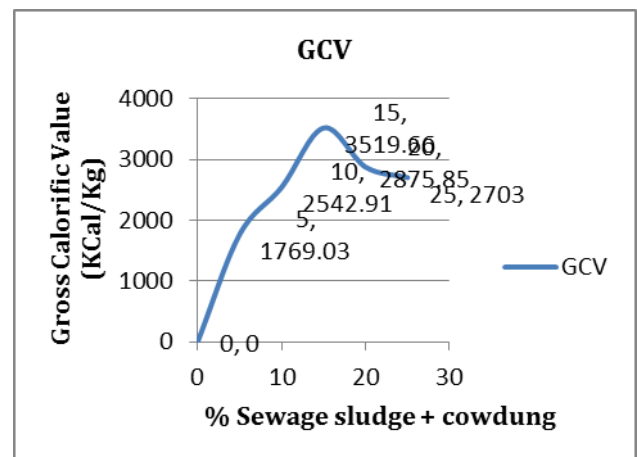
**3.4 Basic Parameters:**

1. Calorific value
2. Combustion time
3. Emission of gasses
4. Density
5. Water content
6. Drying period

**3.5 Tests:**

1. Proximate Analysis
  - a. Determination of Moisture
  - b. Determination of Volatile matter
  - c. Determination of Ash
2. Determination of Calorific value
3. Determination of Sulfur
4. Ultimate Analysis
  - a. Determination of Carbon (C)
  - b. Determination of Nitrogen (N)
  - c. Determination of Hydrogen (H)

**3.6 TEST RESULTS:**



**Fig -2:** Variation of CV with varying % of sludge as that of coal

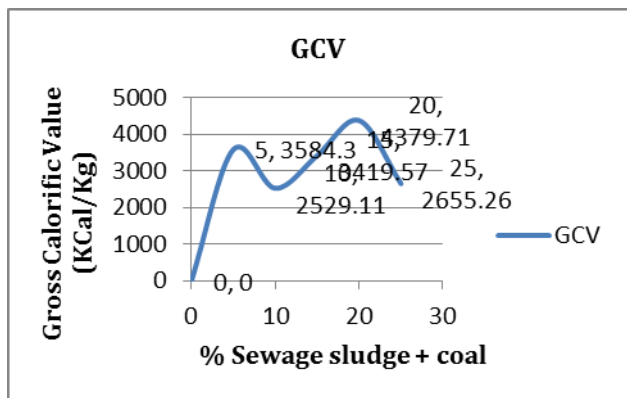


Fig -2: Variation of CV with varying % of sludge as that of cow dung

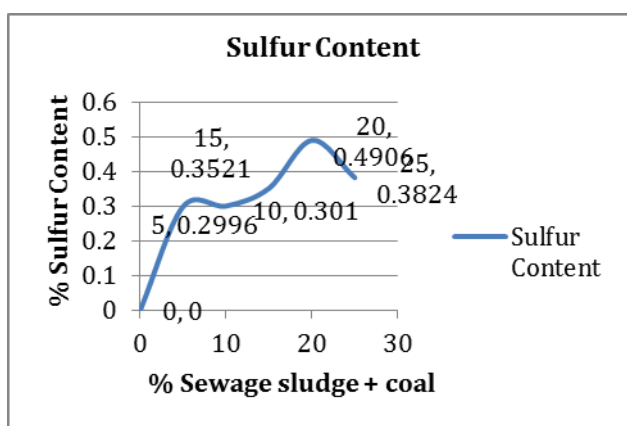


Fig -3: Variation of Sulfur with varying % of sludge as that of coal

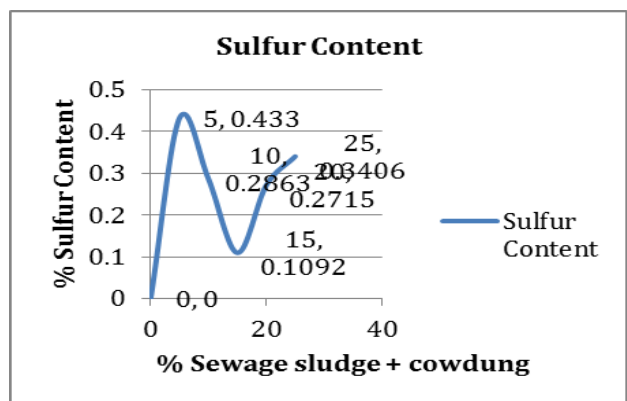


Fig -4: Variation of Sulfur with varying % of sludge as that of cow dung

3.7 Summary:

The above information enlightens us, to framing the problem statement, to set the objective, need and relevance to overcome the social issue of energy consumption. This chapter also help us to define the pathway to achieve the desire objective, which will be helpful for giving the alternate energy source in combination with coal or independently.

4 CONCLUSION

In Pimpri-Chinchwad, huge amount of sewage is generated per year and it is increasing because it's increasing population and development. This sewage is treated in Sewage Treatment Plant.

- The treated sludge is then disposed off by dumping in open spaces/lands, which creates land pollution and odor problems.
- This sewage sludge has combustible properties and also available in ample amount so our approach in this paper is to utilize these properties effectively for the generation of electricity.
- In this study, we used some proportions of sludge along with coal and dried cow dung. This is our try to increase the use of sludge and to decrease the land pollution and odor problem. Also it will reduce the load of disposal of treated sludge.

REFERENCES

- [1] Abhilash T. Nair, M. MansoorAhammed, "Coagulant Recovery From Water Treatment Plant Sludge & Reuse In Post Treatment of UASB Reactor Effluent Treating Municipal Wastewater"- Environ SciPollut Res (2014) 21:10407-10418 DOI 10.1007/s11356-014-2900-1.
- [2] Bogdan Kosturkiewiczand Andrzej Janewicz, "Analysis Of Briquetting Process Of Sewage Sludge With Coal To Combustion Process"-E3S Web of Conferences 10, 00041 (2016) DOI: 10.1051/e3sconf/20161000041
- [3] Khalid Mohd. Breesem, FarisGorashiFaris, "Reuse Of Alum Sludge In Construction Materials And Concrete Works" -Infrastructure university Kuala Lumpur Research Journal Vol. 2 No.1(2014)
- [4] N. Supatata, J. Buates, and P. Hariyanont, "Characterization Of Fuel Briquettes Made From Sewage Sludge Mixed With Water Hyacinth and Sewage Sludge Mixed With Sedge"-International Journal of Environmental Science and Development, Vol. 4, No. 2, April 2013
- [5] V. Siegl, H. Splithoff, R. Cenni, "Fuel Characteristics Of Sewage Sludge & Other Supplemental Fuels Regarding Their Effect On The Co-combustions Process With Coal"

CODES FOR REFERENCE:

1. IS 436-1964
2. IS 1350-1984
3. IS 1448 (P:06),1984
4. IS 1448 (P:33),1991

**WEB REFERENCE:**

1. <http://www.ijesd.org/papers/330-M00034.pdf>
2. [https://www.researchgate.net/publication/309227870\\_Analysis\\_of\\_briquetting\\_process\\_of\\_sewage\\_sludge\\_with\\_coal\\_to\\_combustion\\_process](https://www.researchgate.net/publication/309227870_Analysis_of_briquetting_process_of_sewage_sludge_with_coal_to_combustion_process)
3. [https://web.anl.gov/PCS/acsfuel/preprint%20archive/Files/43\\_1\\_DALLAS\\_03-98\\_0197.pdf](https://web.anl.gov/PCS/acsfuel/preprint%20archive/Files/43_1_DALLAS_03-98_0197.pdf)
4. [https://iukl.edu.my/wp-content/uploads/2016/05/2.-Reuse-of-Alum-Sludge-in-Construction-Materials-and-Concrete-Works-A-General-Review\\_Khalid-Mohammed-Breesem-Faris-Gorashi-Faris-and-Isam-Mohammed-Abdel-Magid.pdf](https://iukl.edu.my/wp-content/uploads/2016/05/2.-Reuse-of-Alum-Sludge-in-Construction-Materials-and-Concrete-Works-A-General-Review_Khalid-Mohammed-Breesem-Faris-Gorashi-Faris-and-Isam-Mohammed-Abdel-Magid.pdf)
5. <https://www.ncbi.nlm.nih.gov/pubmed/24777321>  
[https://www.pcmcindia.gov.in/pdf/esr\\_eng\\_2013.pdf](https://www.pcmcindia.gov.in/pdf/esr_eng_2013.pdf)

**BIOGRAPHIES**



Assistant Professor, Department of Civil Engineering, Dr. D. Y. Patil Institute of Technology Pimpri, Pune-18, Maharashtra, India



Under Graduate Scholar, Department of Civil Engineering



Under Graduate Scholar, Department of Civil Engineering



Under Graduate Scholar, Department of Civil Engineering



Under Graduate Scholar, Department of Civil Engineering



Under Graduate Scholar, Department of Civil Engineering