

# Design, Development and Analysis of Roller Unit Assembly and Guide ring of Calcination Drum

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**Abstract**— Solid waste refers to reuse solid and semi solid waste matters except the night soil. As per Municipal solid waste Management and Handling rules - 2000 , solid waste management is in the obligatory function of urban local bodies, but in actual practice the solid waste management is given the last priority and the duties are either not performed or poorly performed consequently the city has to face numerable problems related to environment and sanitation .The solid waste management approach in India is extremely inefficient, using old and obsolete system technology for storage collection processing, treatment and disposal. Hence by taking into ill effects due to improper disposal of wastes due to which the atmosphere becomes ugly and unhygienic; different methods for recycling are used. Composting is one of the methods which is the biological decomposition of biodegradable solid waste under controlled predominantly aerobic conditions to a state that is sufficiently stable for nuisance-free storage and handling and is satisfactorily matured for safe use in agriculture. In order to perform this process it is necessary that the wastes should be bifurcated into degradable and non degradable ones. This can be done by the specially designed equipment named Calcination Drum.

**Keywords**— Calcination drum, failure analysis of shaft, design of guide ring.

## I. INTRODUCTION

Most wastes that are generated, find their way into land and water bodies without proper treatment, causing severe water pollution. They also emit greenhouse gases like methane and carbon dioxide, and add to air pollution. Any organic waste from urban and rural areas and industries is a resource due to its ability to get degraded, resulting in energy generation.

The problems caused by solid and liquid wastes can be significantly mitigated through the adoption of environment-friendly waste-to-energy technologies that will allow treatment and processing of wastes before their disposal. These measures would reduce the quantity of wastes, generate a substantial quantity of energy from

them, and greatly reduce environmental pollution. India's growing energy deficit is making the government central and state governments become keen on alternative and renewable energy sources. Waste to energy is one of these, and it is garnering increasing attention from both the central and state governments. Calcination drum plays very important role in bifurcating the degradable and non degradable wastes and helps in forming the mixture of waste which is required for formation of methane. Waste materials are renewable source of energy which will not diminish as that of fossil fuels.

Calcination drum is simple cylindrical drum containing an inlet from where waste materials are fed and outlet from where the waste in the form of fine particles are sent to further processing. Inside the drum there are perforated screens and blades which accomplish this task. The drum is rotated by means of 4 rollers rolling along guide ring and external ring gear meshing with a pinion. The guide ring is welded on the drum. When drum is in rotating condition; due to unbalanced of solid waste mass tumbling inside the drum the failure of shaft and bearing of roller assembly takes place also some cracks are seen on guide ring. This problem can be solved by designing the roller assembly and guide ring such that it can withstand loads without failure.

## II. RELEVANCE / MOTIVATION

Most wastes that are generated, find their way into land and water bodies without proper treatment, causing severe water pollution. They also emit greenhouse gases like methane and carbon dioxide, and add to air pollution. Any organic waste from urban and rural areas and industries is a resource due to its ability to get degraded, resulting in energy generation.

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### III. LITERATURE REVIEW

Vijay Kumar and Dr R. K. Pandit [1] have focused on the problems of solid waste management in Indian cities and the sources from which these solid wastes are generated. The land filling practice in most Indian cities is one of the most unscientific and unhygienic practices with serious environmental implications. This paper involves case studies for large cities regarding ingredients of waste generated and also the problems regarding storage of solid waste as there is system of keeping the bio degradable and non Bio degradable waste separately.

Bhushan R. Ambade et al [2].has discussed the opportunities and challenges in Municipal Solid waste management by considering one case study for Nagpur city. He has represented the physical composition of solid wastes in Nagpur city by means of pie chart. The processing of solid wastes in Nagpur is done by composting method. Four windrows in a row were used with size 70 m x 12 m x 2.5 m. The watering was done by spraying water through the showers mounted on crane. Inoculums was added about 50 kg in a windrow to accelerate microbial activities. Windrows were turned four times in a week with the help of crane mounted shovel so that windrows were aerated. The moisture content and aeration was monitored to maintain the hemophilic temperature within the windrows. After 30 days the MSW should be kept at maturation yard for a week. Then it was segregated through 18 mm and 13 mm trowels. Finally it was segregated through 4 mm and 3 mm trowel to separate compost and inert matters. The compost was collected in 50 kg bags and the inert matter was sent for land filling.

Glenn E. et al. [3] has addressed that waste materials of all types are ever increasing so that waste disposal is one of the largest problems facing an ecology-minded society of today. This paper describes the equipment used and the test methods for producing methane. Tests were carried out with different kinds of wastes results based on the amount of methane produced from different types of wastes were discussed.

Gaurav Kumar et al.[4]have focused on solid waste management; its sources and separation methods like handpicking is a long-used form of separation of a few components of solid wastes in which a conveyor moves the solid waste pass by a group of workers who pick up the designated components by hand. This method of separation is costly, and only a few bulky components, such as bundled newspapers and cardboard, can be separated. A mechanized material recovery method utilizes shearers that break open the bags and liberate cans and bottles. Trammel screens separate cans, glass and other inorganic material. The organic material is shredded and passed through air classifiers, which separate the components desired for recovery of fibers for paper making or for producing refuse derived fuel. Magnetic and electromechanical systems separate ferrous and non ferrous metals. The volume of municipal solid waste is greatly reduced by incineration, conversion processes or resource recovery.

Tom L. Richard [5] have focused on various technologies and options currently available for preprocessing Municipal Solid Waste .The steps involved in composting of municipal solid wastes are collection, contaminant separation, sizing and mixing, and biological decomposition. This paper describes different devices like trammel, eddy current separator, air classification etc used to carry out separation of wastes according to their sizes. This paper also describes other devices like hammer mill, shear shredders and rotating drum which are used for size reduction of solid waste particles in order to enhance the composting rates.

### IV. CONCLUDING REMARKS

From the literature survey it can be seen that solid waste management is very important owing to the contamination of environment caused by the non degradable wastes .Presently different separation techniques of solid wastes like screening, magnetic separation, eddy current separation, air classification etc are used. The different devices used for size reduction of solid wastes are also emphasized. Methane generation is possible when the dissolution of solid wastes will be done into two categories i.e. degradable and non degradable as the degradable wastes are utilized for generation of methane. This task is achieved by Calcination drum and hence this is the topic of my interest. In our paper we are going to design the roller unit assembly and guide ring of Calcination drum by considering the input conditions.

## V. PROBLEM STATEMENT

The proposed assigned work is divided into the following phases.

### Phase I

1. Study of existing Calcination drum, its construction and working will be done.
2. Design and development of support roller unit assembly will be carried out which involves:
  - a) Design of support roller shaft.
  - b) Stress analysis and deflection analysis of support roller shaft based on the static and dynamic conditions. (Using CAD / CAE software's like ANSYS) and calculation of stresses.
  - c) Design of key and keyways for shaft.

### Phase II:

- a) Selection of proper journal support bearing for the shaft depending upon static and dynamic load conditions will be done.
- b) Design and development of modified bearing housing parts like housing block base, bearing bottom, top halve etc will be done along with the mounting arrangement as per newly selected bearing.
- c) Modified drawings for bearing housing with its mounting arrangement will be prepared

### Phase III:

Design of roller guide ring will be carried out which involves:

- a) Design of plates (Width, thickness and circumferential length) used for manufacturing the guide ring in order to withstand stresses developed in the ring.
- b) Design of support pads (length, width and thickness) used on which guide ring is welded to the drum.
- c) Design, testing and selection of welded joint specimen according to actual load conditions.

### Phase IV:

- a) Analysis of guide ring and support pads as per actual load conditions (using CAD / CAE software's like ANSYS) will be carried out.
- b) Selection of standard fabrication procedure (welding methodology) for support guide ring, support pads of Calcination drum will be done.

### Phase V:

- a) Preparation of detailed drawings of designed parts for manufacturing department will be done.
- b) Comparison with experimental analysis results for Support roller shaft, Support roller guide ring, Support roller pads will be carried out based on the following conditions:-

- i) Experimental analysis of stress and deflection in the static condition.
- ii) Experimental analysis of stress and deflection in the dynamic condition.

### Phase VI:

Final report on results for roller unit and guide ring will be done and analysis will be presented . After that, Report making will be done.

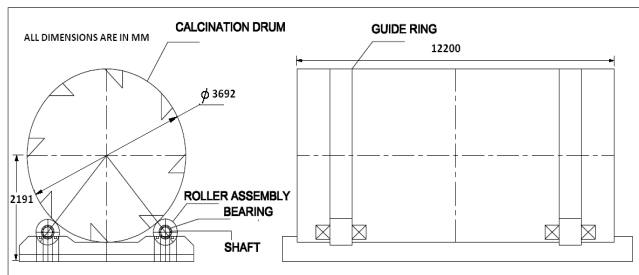
## VI. SCOPE

- i. Well definition of the problem.
- ii. Design of Shaft considering input parameters and loading conditions and analysis by using CAD / CAE software's like ANSYS.
- iii. Selection of bearing according to axial and radial load conditions and design of bearing housing along with its mounting arrangement.
- iv. Suggestion of proper lubricating system for bearing.
- v. Design and analysis of roller guide ring of Calcination drum along with its support pads.
- vi. Preparation of new drawings to avoid present problems.
- vii. Suggestion for welding methodology for guide ring.
- viii. Experimental analysis of stress and deflection in the static condition for shaft, guide ring and support pads.
- ix. Results & discussion on observations
- x. Conclusions on results.

## VII. METHOD

Firstly the basic information regarding Calcination drum will be obtained. Then the loads and torques on different components of roller assembly will be found out. Based on that and the input data obtained from the customer; design of shaft will be carried out under static and dynamic load conditions and analysis will be done by using ANSYS. Then selection of bearing will be done based on axial and radial load conditions and its housing will be designed. After that design and analysis of drum roller guide ring will be carried out .After this whole process detailed drawings will be prepared as per changes in the design and the same will be submitted to the company.

### VIII. PROPOSED EXPERIMENTAL SETUP



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