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Review on Calcination Drum & Solid Waste Management

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Abstract – *Now a day's Solid Waste Management is one of the major challenges faced by many countries around the globe. Inadequate collection, recycling or treatment and uncontrolled disposal of waste in dumps can lead to severe hazards, such as health risks and environmental pollution. The management of solid waste typically involves its collection, transport, processing and recycling or disposal. Collection includes the gathering of solid waste and recyclable materials, and the transport of these materials, after collection, to the location where the collection vehicle is emptied. For generation of energy from municipal solid waste the device named 'Calcination Drum' is developed by Engineers. There are some norms, rules and regulations must have to follow by Municipal Corporation Committee for reuse, recycle and utilization of Municipal sewage solid waste. Under this rules and regulation research and development on generation of Methane gas by using municipal waste is going on.*

Key Words: *Calcination Drum, Solid waste, Calcination Drum setup, etc.*

1] INTRODUCTION:

Solid waste can broadly be classified into two categories. According to Indian MSW, Rules 2000 "Municipal Solid Waste" includes commercial and domestic wastes generated in a municipal or notified area in either solid or semi-solid form excluding industrial hazardous wastes but including treated bio-medical wastes. Solid waste also includes hazardous waste generated by various industries. Municipal Solid Waste (MSW) can further be classified into-

a) Biodegradable Waste: -
Such as food and kitchen waste; Recyclable materials (such as paper, glass, bottles, metals and certain plastics).
b) Domestic Hazardous Waste: -
Such as medication, chemicals, light bulbs and batteries.

Solid waste management is becoming matter of great concern due to increasing population. Generally, in most cities one common method is adopted for waste disposal i.e. dumping on the grounds present outside the cities. If the non-degradable wastes are not dumped properly then it may cause the severe effects like air pollution, diseases etc.; considering all these ill effects it is necessary that the wastes should be dumped properly after segregation (degradable and non-degradable). Hence engineers developed one drum named Calcination Drum. 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 send 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.

Fig.1: Actual Setup of Calcination Drum

In primary stages it was tested and it was found that it encountered some problems as follows:

1. Failure of support roller unit assembly-
a) Failure of support roller shaft.
b) Failure of support roller shaft bearing.

2.Failure of support roller guide ring assembly-
a) Failure of guide ring.
b) Failure of guide packing's and ovality with center axis.

c) Cracks are developed on the support guide ring.
d) Uneven thickness observed on the support guide ring.

3. Failure of welding joints-
a) Failure in alignment.
b) Alignment of calcinations drum and support structure assembly is mismatched due to wear between the guide ring and roller.

4. Calcination Drum Body problems-
a) Because of uneven concentration of sewage waste weight in the drum, there are some difficulties found to maintain the concentricity with structure axis.
b) Thickness of plate selected to fabricate the Calcination drum is needed to be redesigned and analyzed.

5. Misalignments of Calcination drum with support structure-

6. Design problems involved with gear drive-
a) Cracks developed on the gear ring.
b) Same problems are involved which are encountered by support guide ring.

2] Literature Review:

Vijay Kumar [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 the system of keeping the bio degradable and non-Bio degradable waste separately. **Gaurav Kumar** [2] 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 nonferrous metals. The volume of municipal solid waste is greatly reduced by incineration, conversion processes or resource recovery. **Tom L. Richard** [3] have focused on various technologies and options currently available for pre-processing 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. **Heng Long Li** [4] have focused on the optimal design of ride rings for Industrial Rotary Kilns. In this article they have represented the type of modeling analysis and subsequent solution, suitable for design problems which must be solved many times with parameter changes larger than those handled with usual sensitivity analysis. This paper also gives the brief description regarding the typical construction of Rotary Kilns or Calcination Drums which are used in cement processing industries. This paper represents the bending stress distribution and pressure distribution with the help of diagrams. **Ziga Alma** [5] have focused on theoretical and experimental research on stress of a kiln ring. In this paper the stresses in the riding ring of cement rotary kiln are discussed from both theoretical and experimental approach. These stresses are alternating in nature and are caused by forces acting on the ring and by thermal gradients. The most significant stresses are caused by Hertzian contact pressure between the ring and supporting roller. Their highest value is not on the surface but slightly below it. These stresses are responsible for subsurface cracking and pitting damage of kiln ring and roller. In the ring, the bending stress and stress due to temperature gradient along the section height also exists. Theoretical value of stresses will be compared with experimental ones, obtained for the most loaded, middle ring in Cement factory in Kakanj. **Sumesh Krishnan** [6] in his article 'Achieving Mechanical Stability of Rotary Kiln by FEM' have focused on kiln alignment, kiln geometry analysis etc. It was shown that an FEA model could be used to simulate contact between two bodies accurately by verification of contact stresses between two cylinders in contact and comparison with the Hertzian equations. Correct Mechanical Balance can be concluded as an optimum state of the forces and stresses distribution acting on kiln carrying system and the shell. The essential factors which determine this distribution are kiln geometry (ovality) and mutual relations between rotation axes of kiln and support rollers (dynamic relations). The analyses of the circumferential stresses and the contact stresses are implemented in the FE code ANSYS. Subsequently, the required tangential friction stress is obtained in terms of the rolling and sliding contact area condition. This study can be used to solve a fundamental contact problem similar to the roller. The fatigue life curve can provide basis to adjust the axis line deflection more effectively and prevent the accelerated fatigue damage of the roller. In comparison with the previous results, the present results are longer and more rational as the multiracial stress condition including the circumferential stress and the tangential friction stress is considered.

3] **Theory of Calcination Drum:**

Usually a Calcination drum is a multipurpose drum and can be used for variety of applications. Mostly it is used in cement industries for different processing operations. In our project we are going to use it for processing the municipal solid wastes. Calcination Drum or Rotary kilns are found in many processes that involve solids processing. These include drying, incineration, mixing, heating, cooling, humidification, calcinations, reducing, sintering and gas-solid reactions. The most common and industrially important application of rotary kilns is in cement production; all major producers use the rotary kiln as their equipment of choice. Rotary kilns are amongst the most well-established unit operations in the process industry yet are amongst the least understood.

They can be used for 3 purposes: heating, reacting and drying of solid material, and in many cases, they are used to achieve a combination of these aims. In the design of kilns, there are four important aspects to consider from a process engineering point of view, and these are heat transfer, flow of material through the rotary kiln, gas-solid mass transfer and reaction. Roller and shaft of Cement Rotary Kiln supporting roller is exposed to high stresses under heavy working situation. High Stresses because of big kiln dimensions cause damage to roller and shaft of supporting roller mechanisms. This requires that, decreased stresses provide longer life and decreased damaged to roller and shaft of supporting roller with material properties and working conditions. Active researching and development of the mechanics of cement factories equipment's are not studied in the cement industry. Researching roller and shaft of supporting roller will be useful in the cement industry and is not a good candidate for experimentation due to economic reasons. However, engineers use model in the computer analysis program with original dimensions of subjects and engineers do complex model analysis with the aid of computer. The material properties and working situations are given to analysis program on the computer veritably. Roller and shaft model is drawn and analysis done in order to get critical stresses results.

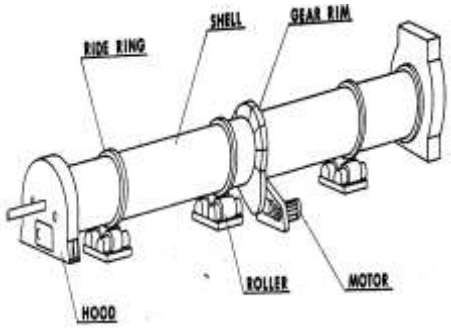

Fig.2 Construction of Calcination Drum.

The Fig. 2 shows the typical construction of Calcination drum. This type of construction has variety of applications like drying, dehumidification, cement, ore-processing and chemical etc. The drum shown in above fig consists of a cylindrical shell slightly inclined from the horizontal position and supported by ride-rings (often called tires) riding on the pair of rollers. A gear rim and pinion assembly rotate the entire system. Material enters the drum at upper end and moves towards the lower end with continuous mixing and supply of hot air. The desired chemical reaction is completed at the lower end and thus the processing is continuous.

4] Concluding Remarks:

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.

5] References:

[1] Kumar V., R. K. Pandit, "Problems of Solid Waste Management in Indian Cities" International Journal of Scientific and Research Publications, Vol. 3, Issue 3, pp 1-9, 2013.

[2] Gaurav K. Singh, Kunal Gupta, and Shashank Chaudhary, "Solid Waste Management: Its Sources, Collection" International Journal of science, vol. 3, Issue 2, pp. 313-317, 2004.

[3] Tom L. Richard, "Municipal Solid Waste composing physical processing" Department of Agricultural and Biological Engineering, Cornell University, Ithaca, NY 14853.

[4] Heng Long Li, "A Contribution to Optimal Design of Ride Rings for Industrial Rotary Kilns." Great Britian: Gordon and Breach Science Publishers, Inc and OPA Ltd. 1984.

[5] Ziga Alma, H. F. "Theoretical and Experimental research on stresses of a kiln ring" 13th International Research Conference in the Development of Machinery and Associated Technology, pp. 517-520, Tunisia, 2009.

[6] Krishnan, S. "Achieving mechanical stability of rotary kiln by FEM" International Journal of Advanced Technology in Engineering and Science, pp. 568-580, 2014.