ISSN No:-2456-2165

Design and Fabrication of Slugde Drying Machine

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Abstract:- **The purpose of this study is to investigate drying of the semi-solid sludge into the powder form with the help of drying machine. Drying machine is nothing but the setup or equipment to dry sludge. Sludge is a waste which is come out from the dairy plants, food industries, agricultural, ceramic and other such industries from Effluent Treatment Plant (ETP) Department. The drying machine temperature is between 140°C - 150°C. After drying process, this powder form can be use in various formed such as fuel in boiler, construction sites, roads, bricks and fertilizers also.**

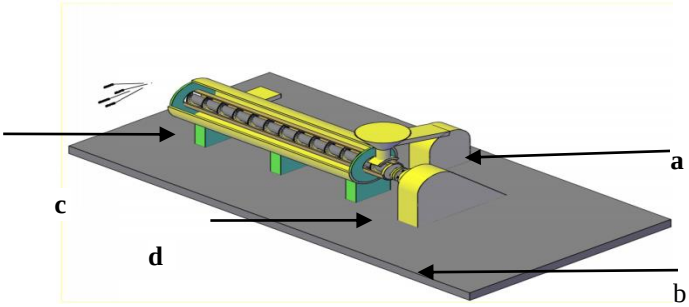
Keyword:- *sludge, ETP, drying machine, extruder, powder sludge, etc.*

I. INTRODUCTION

This research paper is about the drying of the sludge. Sludge is come out from the food industries and dairy industry and different type of industry. Which is drain there wastewater without treating them. Drying is an essential operation in the chemical, agricultural, biotechnology, food, polymer, ceramic, pharmaceutical, pulp and paper, and wood processing industries. Drying is the extremely energy-intensive and in many cases has important implications as the thermal energy needed for drying is obtained by combustion of fossil fuels, leading to emission of carbon dioxide.

There is a need for technological options which can effectively treat the rapidly accumulating sludge under this condition. This study explored a drying of sludge by the use of drying machine, which is based on the screw conveyor into which hot gases (or coil wound) inside the cylinder. It is rapid and efficient in sludge sanitation (pathogen reduction) and drying. When 1KG of semi-solid sludge is entered into the drying machine we will get up to 80%-90% of powder form. This powder is further used in agriculture as organic, during construction of roads, in boilers as fuel also.

Diagram



a. Inlet Hopper
b. Electric motor
c. Outlet
d. Screw

II. MATERIALS AND METHODS

The sludge produced at different dairy, food, ice cream plant. The sludge is generally containing cupcakes plastic, wooden sticks, bags, wastewater after cleaning of tanks, and other impurities which are included in waste. Larger size particles (above 10mm size) which are separate out by screening process and further pass to equalization and biological treatment process for formation of sludge. After biological process this waste is passed through the decanter. Decanter is machine which separate out water and sludge. The separation quantity is about 30%-70% (sludge and water). Water is used for gardening and other processes but sludge are dry with the conventional way i.e. by thermal drying (solar energy and bed).

For drying of sludge there are many methods such as by thermal drying (Conventional drying), microwave drying, solar energy drying system, pneumatic and flash drying and other such methods for drying. Here we are used sludge drying machine as name indicated by drying of sludge. It contains extruder, steam or (heating coils), hopper, motor, crusher, thermo couples, pressure indicator, etc.

Feeding of sludge into the machine by the hopper, which is give proper feeding to sludge. Then sludge is passed through the extruder. Extruder is rotated with the help of motor to maintain speed there is gear train to reduce the speed of the extruder. There are two cylinders which cover the extruder (Internal and External) for separation of sludge and steam or (heating coils). In this machine there are two choices, one is steam and other is heating coils. Steam is used in those areas or industry where there is large amount of steam is waste or removed. And heating coil are used anywhere you required and fast drying. At time of transfer of sludge through extruder, steam is passed through the internal and external cylinder for drying. The inlet temperature is about 140-150 degree Celsius. This temperature is enough for drying sludge. There is heat transfer process takes place between internal cylinder and sludge. External cylinder is gives the protection to operator and avoid accident.

After drying the outlet of the sludge is dry but in granular form. At the end provides crusher to convert it into powder forms. This powder form sludge is used in manufacturing of bricks, construction sites, and road making, in boilers, fertilizer in agriculture also.

III. CALCULATION

A. Heat Energy Calculation Of Sludge Drying

In water treatment plant, we need to be evaporated water or reactivated sludge (MLSS) and chemical sludge. In this case we should know the heat energy calculation for sludge drying.

It is help to analyze quondam of Heat Energy required to evaporate such a medium.

Ok, for example, we'll take a sludge containing 80% water is to be dried at 100 ^{0}C down to moisture content of 10%. If the initial temperature of the sludge is 21 ^{0}C, calculate the quantity of heat energy required per unit weight of the original material, for drying under atmospheric pressure.

The latent heat of vaporization of water at 100 ^{0}C and at standard atmospheric pressure is 2257 KJ/Kg^{0}C. The specific heat capacity of the sludge is4.18KJ/Kg^{0}C and of water is 4.187KJ/Kg0C (Specific heat of sludge, equal to the specific heat f water).

Calculating for 1 Kg sludge initial moisture = 80%

800gm moisture is associated with 200gm dry matter

Final moisture = 10%, 100gm moisture are associate with 900gm dry matter

Therefore (100*200)/900gm = 22.2gm moisture are associate with 200gm dry matter

1Kg of original matter must lose (800-22) 0gm moisture = 778gm = 0.778Kg moisture

Heat energy required for 1Kg original material

= heat energy to raise temperature to 100 0C + latent heat to remove water

= (100-21)*4.18+0.778*2257

=330.2+1755.9

2086KJ

Energy/Kg water removed, as 2056 KJ are required to remove 0.778Kg of water

=2086/0.778 = 2681 KJ

Now we can select the sources of heat generator like boiler, electric power or solar energy.

B. Steam Calculation

We have steam at temperature (T) = 150 0C

- Absolute pressure (P) = 4.8bar
- Specific volume of steam (Vg) = 0.370 m3/Kg
- Specific enthalpy of steam (hg) = 2707.36 KJ/Kg

Volume occupied in m3 by 1Kg of steam

As volume between outer and inner cylinder = 26418830.72 mm3 = 0.02641 m3

Steam holding capacity at a time = 0.0264/0.370*1 = 0.0713 m3 = 0.19Kg

Steam flow rate through volume of 0.0713 m3

As steam flow rate = 500Kg/hr = 013 Kg/ sec

(From blower to outlet)

Total heat contained by 1Kg of steam

As 1Kg of steam contain 2707.36 KJ of heat energy

As in 1 sec 0.13Kg of steam floe through the system produced 351.956KJ of heat energy

Heat energy required to dry 1 Kg sludge = 2681 KJ/Kg

Heat flow through cylinder (Q) =ΔT/R

Therefore, temperature at the inside of the copper cylinder (T2) = 132.23 0C

To which at 1.3223 Kg of sludge get dry in 1 Hour

IV. CONCLUSION

The most appropriate technique to dry high moisture contain in the sludge from the decanter. In which removal of water contain up to 90% from the sludge for drying purpose. The drying system is generally used in the machine by using steam and heating coil as per requirement. Most of the industries released steam as a waste so that this steam is used for drying the sludge. Weather the heating coil is used in anywhere for drying. This sludge converted into powder form after drying. Powder is generally used for agriculture purposed, construction sites, etc.

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