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Sludge Treatment System

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Abstract: sets of environmental scientists from all leading countries have predicted that the sources of sweet water are losing their strongholds and are expected to deploy overtime. It is also known that with increase of demand with respect to growth in population, pollution of water is increasing. Also uses of pesticides, insecticides and synthesized fertilizers are being used to increase the productivity in the field of agriculture and also, it compromises the health of the consumers. In short, we can conclude that these agricultural items say vegetables, pulses etc. Where these synthesized products are used not only kills the pests but also affects the health of the consumer by causing diseases which might be cancer.therefore, in this project, we will be conceptualizing a method to overcome with the solution, for the problem that we have mentioned earlier. And therefore, we will be trying to come up with a design with which we may be able to deliver a system that not only gives us pure water but also one of the best kind of organic fertilizers which will increase the productivity of the agricultural products and will be safe for the consumers. Here we will be using sludge, a polluted water source, mixed with organic and inorganic waste available in sewage or drains with abundancy. As our main medium from which we will be extracting water by compressing the sludge in the piston-cylinder mechanism and the compressed sludge cake obtained from the cylinder is dumped in the composting unit to convert it into manure, i.e. Organic fertilizers. So, in short here we will be using one of the most polluted source of water (mixed with organic and inorganic waste) to produce sweet water so that water scarcity can be limited and abundancy of sweet water is sustained also we will be using the extracted sludge cake to convert it into fertilizers. Therefore, we will be converting a single complete waste product which is very harmful for humans into two such important things, which will play one of the most important role in the existence of life in the earth. Therefore, "we go green and we grow clean".

Keywords: insecticides, organic fertilizers, pesticides, sewage sludge, water scarcity.

I. INTRODUCTION

Sludge are defined as the contaminated water sources which is either generated by direct imposting of pollutants or indirect imposting of pollutants. Polluted water when gets mixed with organic and inorganic waste tends to decompose the organic matter by the processes involving oxidation and reduction to produce hydrocarbon components and a dark slimy semi liquid [3].In general sludge contains 40 to 80% of water in it [5]. The water acts as a medium to carry and mobilize micro-organisms on to different parts of organic waste where it is decomposed by then. Sludge can be classified into different grades depending upon water content, chemical components, organic and inorganic matter, hydrocarbons and gases present.The major components of sludge with ratio are-Water (40-70%),Organic waste/biodegradable substances (25-40%) and Inorganic waste such as plastics (10% to 20%)Sludge are considered to be the most abandoned form of polluted water source. The reason behind this is that all the wasted water goes to the sewage system where it can mix with other components and chemical reaction such as oxidation takes place.

A. Objective Of The Study

1) To design a system which can separate water and solid matters from sludge.
2) Converting the biodegradable waste from sludge into organic fertilizer.

II. METHODOLOGY

It consist of large sludge containing vessel known as Silo, kept at an elevation, to accommodate sludge with the focus of gravity as well as an external pump (vacuum). A pipe is connected from the silo to the separating chamber. The separation chamber consists of wire meshes, having different space gap. A secondary storage is provided beneath the separating unit to collect the refined sludge and wait till the sludge is delivered to the piston cylinder mechanism. Also a pump is installed into the water collecting system so that extra water can be sprayed into separating chamber for smooth process. Holes are provided in the separating chamber for removal of unwanted materials (like plastic, pet bottles,polythene etc). It is also necessary to provide proper corrosion allowance into the piston cylinder assembly as

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there is a chance for continuous deterioration of metal in the form of rusting because of moisture present in the sludge causing oxidation. To make the process smooth, water is sprayed into the separating unit from the water reservoir. The refine sludge now enters the secondary storage tank. From this tank sludge goes into the compressing chamber also known as the piston cylinder assembly. The piston moves forward to compress the sludge. Compression leads to extraction of water and accumulation of sludge at the end making it a semi-dry cake like structure which also called sludge cake. This sludge cake is drawn out from the cylinder outlet and dumps the cake into the composting box. The extracted water goes to the water storage container from which can be used for further treatment. Also a portion of this water is used for smoothing the flow of sludge into the separating chamber.

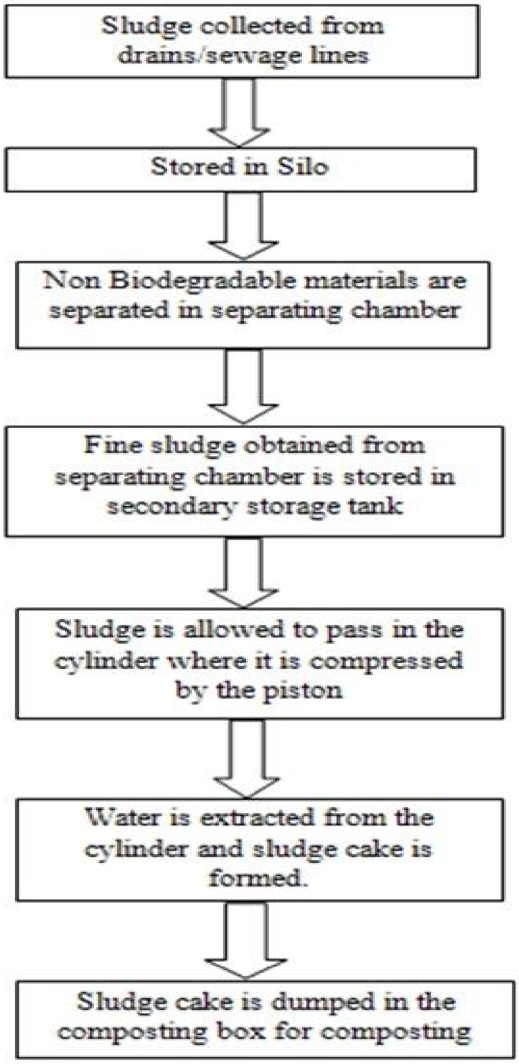

Figure-1: Flowchart of sludge treatment system

III. DESIGN AND CALCULATION

A. Design of Silo: A Silo is a structure for storing bulk materials.

*1)*Material of the Silo: Due to light weight, corrosion resistance and low cost, Aluminium is chosen.

2) Calculation

Density of the sludge = 1400 kg/m^3 [Water research commission report]

The intake capacity of the system is 500 kg of sludge.

So, m = 500 kg, which the total mass of sludge that can be stored in the silo.

Now, the volume that the sludge will occupy inside the silo will be as

$V_s = \frac{m}{\rho}$ Where, V_s = volume of sludge

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$\Rightarrow V_s = \frac{500}{1400}$ m = mass of sludge

$\Rightarrow V_s = 0.357\ m^3$ ρ = density of sludge

$\Rightarrow V_s = 357.14$ liters [∵ $1m^3=1000$ liters]

Hence, the volume of the silo is being considered as 362 liters i.e 0.362 m^3 (500 kg weight)

3) Silo or primary storage tank – The primary storage tank has the cylindrical shape where volume is given by the formula $\pi r^2 h$.

$V_{silo} = 0.362\ m^3$ Where, V_{silo} = volume of silo, h = height of silo

$\therefore \pi r^2 h = 0.362\ m^3$ r = radius of silo

$\Rightarrow r = 0.339$ m [∵ h = 1m]

∴ diameter of the silo, d = 0.678 m (considering the silo to be a thin cylinder)

$\therefore \frac{t}{d} < 0.07$ [Design Data hand book K.Mahadevan]

$\Rightarrow t < 0.07\times0.678 < 0.04752$ m. Consider thickness (t) for the silo to be 10 mm.

B. Sewage Pump

For the free movement of sludge a submerged sewage pump of the following specification is selected –Head range (m) = 2 - 9 m, Suction × delivery (mm) = 40×40 (mm) , Phase: Single phase

Discharge range (LPM): 15-190 LPM, Motor power: 0.55 kW , Power (HP): 0.75 H.P

Voltage: 220 V, Model No: CDJP – 550, N (rpm) = 2000 rpm

C. Orifice in the silo

There is a small opening in the silo through which the sludge will be moving out to the separating chamber.Now, discharge (Q) of the pump = 15 -190 LPM

We take Q = 80 LPM

$\Rightarrow Q = 80\times\frac{1}{1000}\times\frac{1}{60}$ [∵ $1m^3=1000$ liters]

$\Rightarrow Q = 1.333\times10^{-3}\ m^3/sec$

Now, mass flow rate $\dot{m} = \rho AU$ Where, ρ = Density of sludge , U = Velocity flow of sludge

Also , $\dot{m} = \rho Q$ A = Area of the orifice

$\Rightarrow \dot{m} = 1400\times1.333\times10^{-3} = 1.866$ kg/sec

Mass flow rate through orifice, $\dot{m} = 1.866$ kg/sec

Now, $\dot{m} = \rho AU$

We consider the diameter to be (d) =12 cm = 0.12 m

$$\Rightarrow U = \frac{\dot{m}}{\rho A} = \frac{1.866}{1400\times\frac{\pi}{4}\times(0.12)^2} = 0.117\ m/sec$$

∴ The velocity of flow of the sludge is U = 0.117 m/sec

Now, an L-bent pipe of diameter (d) is connected = 0.12 m to the orifice.

The length of the pipe will be 50 cm = 0.5m

D. Separating Chamber

Considering the length of the separating chamber to be 1.5m, this consists of three sections. Each Section is equipped with a wire mesh placed equally at 0.45m apart keeping a tolerance of 0.15m at the bottom part of the separating chamber.Total volume of separating chamber = $0.362m^3$

Volume of each section = $\pi r^2 h$ (r = radius of the separating chamber)

$\therefore \pi r^2 h_1 + \pi r^2 h_2 + \pi r^2 h_3 = 0.362$

$\Rightarrow \pi r^2 (h_1 + h_2 + h_3) = 0.362$ (h = gap between the consecutive wire mesh)

$\Rightarrow \pi r^2 (0.45 + 0.45 + 0.45) = 0.362$

$\Rightarrow r = \sqrt{\frac{0.362}{1.414}} = 0.50$ m ∴ diameter of the separating chamber,d = 1m

E. Wire Mesh

1) Material Used **:** Stainless steel is selected due to higher corrosion resistant, lower maintenance, higher strength and hardness.

2) Description

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In the separating chamber, three wire meshes of different sizes are used to form three different layers, welded at a distance of 0.45m apart.

3) Specification

Screen opening for the wire meshes-

For top layer = 50mm, For middle layer = 30mm and For bottom layer = 20mm

4) Calculation

Area of wire mesh = πr^2 Where, r = radius of separating chamber

$\Rightarrow r = \frac{d}{2} = \frac{1}{2}$ [$\because$diameter of separating chamber d = 1m]

$\Rightarrow r = 0.5m = 500mm$

Area = $\pi (0.5)^2 = 0.785\ m^2$

F. Secondary storage tank

Secondary storage tank is the chamber to which fine sludge will be stored for further processing. All impurities, solid particles (non-biodegradable particles) will be separated out .

Secondary storage tank consist of two sections-

Section 1 is cylindrical portion and Section 2 is conical portion

Considering section 2 to be a conical shape since it will ease the movement of sludge due to the force of gravity on the sludge converging downwards.

$\therefore$ Volume of secondary storage tank will be -

V_{tank} = (volume of cylindrical portion) + (volume of conical portion)= $\pi r^2 h_1 + \frac{1}{3}\pi r^2 h_2$

Where, r = radius of the chamber, h_1 = height of the cylindrical portion, h_2 = height of the conical portionVolume of the secondary storage tank, $V_{tank} = 0.8m^3$, $h_1 = 0.7m$ and $h_2 = 0.2m$

$\therefore V_{tank} = \pi r^2 h_1 + \frac{1}{3}\pi r^2 h_2$

$\Rightarrow 0.8 = \pi r^2(0.7) + \frac{1}{3}\pi r^2(0.2)$

$\Rightarrow r = 0.576\ m$ $\therefore d = 1.15m$

Now, slant height (l) of the conical portion is given by

$\sin\theta = \frac{h_2}{l}$

Where, θ = angle of the cone

$\because \tan\theta = \frac{h_2}{r} \Rightarrow \theta = \tan^{-1}(\frac{0.20}{0.576}) \Rightarrow \theta = 19.14^o$

Now, $\sin\theta = \frac{h_2}{l} \Rightarrow l = \frac{0.20}{\sin 19.14} = 0.609$ m. Therefore,the slant height of the conical section, l = 0.609 m

G. Cylinder

This system consists of a cylindrical chamber of stainless steel which is open at both the ends. One end is provided with a fine wire mesh of 1000 microns. Here the sludge is compressed with the help of piston to extract water from the sludge, so as to make sludge in the cake form, ready for composting.

1) Calculation

Density of sludge $\rho = 1400\ kg/m^3$

For sludge of mass 10 kg

Volume occupied, $V = \frac{m}{\rho} = \frac{10}{1400} = 7.142 \times 10^{-3}\ m^3$

Considering bore of the cylinder, $d = \frac{l}{2}$ where l= length of stroke

Swept volume $= \frac{\pi}{4} d^2 l$

$\Rightarrow 7.142 \times 10^{-3} = \frac{\pi}{4}(\frac{l}{2})^2 l$

$\Rightarrow l = 0.331\ m = 331.345\ mm$

$\therefore d = \frac{0.331}{2} == 0.1656\ m$ $\because d = \frac{l}{2}$

Area of bore, $A = \frac{\pi}{4} d^2 = 0.02153\ m^2$

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Now , clearance volume = (swept volume – 40% of swept volume)

$=7.142 \times 10^{-3} - 0.4 \times 7.142 \times 10^{-3}$ [∵ sludge has 40-60% of water content]

$= 4.2852 \times 10^{-3}\ m^3 = 4.2852$ liters

Thickness (t) of the cylinder, considering it to be a thin cylinder

$\frac{t}{d} < 0.07$ [design data handbook K.Mahadevan]

$t < 0.07 \times 0.165 < 0.0115\ m < 11.59$ mm

Considering thickness (t) to be 10 mm

Outer diameter of the cylinder = (d + t).= 0.1656 + 0.01 = 0.1756m = 175.6 mm

H. Piston

The Physical and material properties of Aluminum Alloy are given below [9]:

Density – 2770 (Kg/m3)

Poisson Ratio – 0.33

Young Modulus – 7.1×1010 (Pa)

Tensile Ultimate Strength – 3.1×108(Pa)

Tensile Yield Strength – 2.8×108(Pa)

Compressive Yield strength – 2.8 ×108(Pa)

1) Calculation

Piston diameter = bore of the cylinder= 0.1656m

Piston area $= \frac{\pi}{4} d^2 = \frac{\pi}{4}(0.1656)^2 = 0.02153 m^2$

Calculations-

2) hickness of Piston Head (t_H) : The piston thickness of piston head calculated using the following Grashoff's formula [9],

$t_H = \sqrt{\frac{3pD^2}{16\ \sigma t}}$ where, P = maximum pressure in N/mm² = 8 N/mm².

This is the maximum pressure that Aluminium alloy can withstand.

D= cylinder bore / diameter of piston = 165.6 mm ,

σ_t = permissible tensile stress for the material of the piston =280/2.25=124.4 MPa. (Factor of safety = 2.25)

$t_H = \sqrt{\frac{3 \times 8 \times (165.6)^2}{16 \times 124.4}} = 18.184$ mm

3) Radial Thickness of Ring (t_1):

$t_1 = \sqrt{\frac{3D^2Pw}{\sigma t}}$ Where, D = cylinder bore in mm = 165.60mm. σ_t= 124.4Mpa for aluminum alloy

P_w= pressure on cylinder wall in N/mm². Its value is limited from 0.025N/mm² to 0.042N/mm². Here Pw value is taken as 0.042N/mm². P_w=0.042 N/mm2

$t_1 = \sqrt{\frac{3 \times (165.6)^2 \times 0.042}{124.4}} = 5.27$ mm

4) Axial thickness of ring (t_2)

Considering $t_2 = 0.7\ t_1$ to $t_1 = 0.7\ t_1 = (0.7 \times 5.27) = 3.689$ mm

5) No. of rings (n_r)

Minimum axial thickness (t_2)

$t_2 = \frac{D}{10 \times n_r}$

$n_r = \frac{D}{10 \times t2} = \frac{155.6}{10 \times 3.466} = 4.48$ rings = 4 or 5 rings

6) Width of the top land (b_1)

$b_1 = t_H$ to $1.2\ t_H = 1.2\ t_H = 1.2 \times 18.184 = 21.82$mm

7) Width of the other land (b_2)

$b_2 = 0.75 t_2$ to $t_2 = 0.75\ t_2 = 0.75 \times 3.689 = 2.76675$ mm

Piston pin diameter(d_o)

$d_o = 0.03D = 0.03 \times 165.6 = 4.968$mm

8) Mass of piston

$m = \rho \times V$ [$\because \rho = 2770\ kg/m_3$]

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$V=\frac{\pi}{4}\times D_2\times t_H=\frac{\pi}{4}\times(0.1656)^2\times(18.184/1000) = 3.196\times10^{-4}\ m^3$

Therefore, $m = 2770 \times 3.196\times10^{-4} = 1.08$ kg

I. Connecting Rod

1) Description- This system consists of connecting rod which connects the piston to the crank or crankshaft.Its primary function is to transmit the push and pull from the piston pin to the crank pin, thus converting the reciprocating motion of the piston into rotary motion of the crank.
2) Material used-Carbon steel
3) Calculation

A = cross sectional area of the connecting rod. L = length of the connecting rod.
C = compressive yield stress. W_{cr} = crippling or buckling load.
I_{xx} = moment of inertia of the section about x-axis, K_{xx} = radius of gyration of the section about x-axis
I_{yy} = moment of inertia of the section about y-axis. K_{yy} = radius of gyration of the section about y- axis.
D = Diameter of piston r = Radius of crank σ_c = compressive yield stress
According to rankine formulae [Machine design: RS Khurmi]
W_{cr} about x-axis = $(\sigma_c\times A)l + (L\times K_{xx})^2 = (\sigma_c\times A)l + a\,(l\times K_{xx})^2$ [∵ for both ends hinged L = l]
W_{cr} about y-axis = $(\sigma_c\times A)l + (L\times K_{yy})^2 = (\sigma_c\times A)l + a\,(l\times K_{yy})^2$ [∵ for both ends fixed L = l/2]
In order to have a connecting rod equally strong in buckling about both the axis, the buckling loads must be equal. i.e.$\Rightarrow \sigma_c\times A)l + a\,(l\times K_{xx}) = (\sigma_c\times A)l + a\,(l\times K_{yy})^2$

$\Rightarrow K^2_{xx} = 4K^2yy$ [or] $I\,xx = 4Iyy$ [$\therefore l = A \times K^2$]

This shows that the connecting rod is four times strong in buckling about y-axis than about-axis. If $I_{xx} > 4I_{yy}$, Then buckling will occur about y-axis and if $I\,xx < 4I_{yy}$, then buckling will occur about x-axis .In Actual practice I_{xx} is kept slightly less than $4I_{yy}$. It is usually taken between 3 and 3.5 and the Connecting rod is designed for buckling about x-axis. The design will always be satisfactory for buckling about y-axis. The most suitable section for the connecting rod is I-section.
Area of the cross section = $2[4t \times t] + 3t \times t = 11t^2$
Moment of inertia about x-axis = $2[4t^2]+3t^2=11t^2$
And moment of inertia about y-axis, $I_{yy} = 2\times\frac{1}{12}\times t\times(4t)^3 + \frac{1}{12}\times(3t)t^3 = \frac{131}{12}\times t^4$. Then, $\frac{I_{xx}}{I_{yy}} = \frac{419}{12}\times\frac{12}{131} = 3.2$
Since the value of $\frac{I_{xx}}{I_{yy}}$ lies between 3 and 3.5 m therefore I-section chosen is quite satisfactory.
Thickness of flange & web of the section = t , Width of section B= 4t
Height of section H = 5t , Area of section A= $2(4t^2) +3t^2 = 11t^2$
M.O.I of section about x axis: $I_{xx} = \frac{1}{12}\times [4t\,\{5t\}^3 - 3t\,\{3t\}^3] = \frac{419}{12}\times t^4$
MI of section about y axis: $Iyy = 2\times\frac{1}{12}\times t \times (4t)^3 + \frac{1}{12}\times (3t)t^3 = \frac{131}{12}\times t^4$. Then, $\frac{I_{xx}}{I_{yy}} = 3.2$

4) Calculations

Factor of safety- 5 to 6

a) Thickness of the flange and web of the section (t)

$$W_B = \frac{\sigma A}{1+a(\frac{L}{K_{xx}})^2} = 37663\ N \qquad \text{Where, } \sigma = 415\ MPa$$

$$K_{xx} = \frac{I_{xx}}{A} = 1.78t \qquad a = \frac{\sigma}{\pi^2 E} = 0.0002 \quad \text{[constant]}$$

L = length of the connecting rod = 2 × stroke length = 2l = 2 ×331.33 = 662.66 mm
Substituting the values in the above equation, we get

$$W_B = \frac{415\times 11t^2}{1+0.0002\,(\frac{662.66}{1.78t})^2} = 37663 \Rightarrow t = 4.449\ mm$$

b) Width of the section B =4t = 4×4.449 =17.796 mm
c) Width of the section H =5t = 5×4.4449 = 22.245 mm
d) Cross-section area of the connecting rod, A=11 t^2 = $11\times(4.449)^2$ = 217.73 mm^2
e) Length of the connecting rod (L) = 2 times the stroke =2l = 2×331.33mm =662.66 mm
f) Radius of crank (r) = $\frac{\text{Stroke length}}{2} = \frac{l}{2} = \frac{331.33}{2} = 165.665$ mm

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g) Ratio of the length of connecting rod to the radius of crank, $N = \frac{L}{r} = \frac{662.66}{165.66} = 4$

h) Maximum inertia force of reciprocating parts

$F = mr\omega^2(\cos\theta + \frac{\cos 2\theta}{n})$, N=720 rpm

$\omega = \frac{2\pi N}{60} = \frac{2\pi(720)}{60} = 75.398$ rad/s and $\theta = 0^o$

$F = 1 \times 0.16566 \times (75.398)^2 \times (\text{Cos } 0 + \frac{\text{Cos } 2(0)}{4}) = 1176.765$ N

i) Inner diameter of small end

$d_1 = \frac{F}{Pb_1 l_1} = \frac{1176.765}{12.5 \times 1.5 d_1} = 7.92$ mm = 8 mm (where $l_1 = 1.5 d_1$ and P_{b1} = 12.5 to 15.4 N/mm^2)

j) Length of the piston pin, l_1 = (1.5 to 2) $d_1 = 1.5 \times 8 = 12$ mm

k) Outer diameter of the small end = $d_1 + 2t_b + 2t_m$ = 8 + (2 × 2) + (2 × 5)
= 22 mm Where thickness of the bush (t_b) = 2 to 5 mm

Marginal thickness (t_m) = 5 to 15 mm

l) Inner diameter of the big end, $d_2 = \frac{1176.765}{P_{b2} \times L_2} = \frac{1176.765}{10.8 \times d1} = \frac{1176.765}{10.8 \times 8} = 13.619$ mm

And P_{b2}=designing bearing pressure for big end =10.8 N/mm^2 to 12.6 N/mm^2

m) Length of the crank pin, l_2 = 1.0 to 1.25 $d_2 = l_2 = d_2$ =12.18 mm

J. Gear

Spur Gear , N = 720 rpm, Transmitting power = 5kw, No. of pinion =21
No. of Gear =40, Module =5 mm, Face width =10 m, Full depth involute,
Ultimate tensile strength for pinion material =600N/mm^2, Tooth system =20^0
Ultimate tensile strength for Gear material =400 N/mm^2, Service factor =1.25
Load concentration factor =1.6, Strength of gear < strength of pinion
Pitch line velocity (v)= π×Dp ×Np/(60,000) = 3.9585 m/s
Theoretical tangential force (Ft) $= \frac{5000}{3.9585} = 1268$ N ≈ 1200 N, Height of the tooth =11.25 mm

K. Water tank

Material used: Thermosetting plastic is used due to low cost, durability and good mechanical properties.

1) *Description:* In this system, there is a water tank which has two chambers: chamber 1 and chamber 2. The water that will be extracted after the compression of the sludge, through mesh provided, at the extreme end of the cylinder, is collected in the first chamber.The water that is present in the first chamber is reused to add water to the sludge and making it more slurry by spraying it through the nozzle connected at the top part of the separating chamber. This is done so as to make the sludge movement easy through the wire mesh in the separating chamber by not allowing the sludge to get stuck.When the water in first chamber is filled up it then overflows and get collected in the second chamber .From which the water, is sent for further purification process and can be used for domestic and industrial purpose.
2) Calculation: Considering the diameter and height of the water tank to be 0.5m
   Volume is given by $V_T = \pi r^2 h_T$ Where, r_T = radius of water tank, h_T = height of the water tank,
   $V_T = \pi \times (0.5)^2 \times (0.5) = 0.393\text{m}^3$
3) *Water pump specifications-*

Current: 3.8 A, Pump lift: 5m/16 feet Voltage: 12 v
Outlet pipe diameter: 1-1/8" (29mm), Cable length: Approx 1m/3feet
Base dimension: Approx (145×140×78mm) Height: Approx 100mm

4) *Nozzle:* A nozzle is a device designed to control the direction or characteristics of a fluid flow (especially to increase velocity) as it exits (or enters) an enclosed chamber or pipe[16,17].A nozzle is often a pipe or tube of varying cross sectional area, and it can be used to direct or modify the flow of a fluid. Nozzles are frequently used to control the rate of flow, speed, direction, mass, shape, and/or the pressure of the stream that emerges from them. In a nozzle, the velocity of fluid increases at the expense of its pressure energy.
5) *Nozzle selection:* Spray nozzle is used since it distributes a liquid over an area, to increase liquid surface area, and create impact force on a solid surface.

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III. MACHINE DESCRIPTION

Sludge from the sewage pipelines is stored in the silo or primary storage tank. From Silo, the sludge is allowed to move through the pipe provided in the silo, to the separating chamber by the action of vacuum pump and gravity which creates vacuum to pump out the sludge. When the sludge moves through the separating chamber, the solid particles like plastic bottles, cans, plastic rags, etc are separated out by the wire mesh welded in the separating chamber. Thus, separating chamber acts as a filtration unit. Now, the fine sludge moves through the separating chamber to secondary storage tank. There is a valve provided beneath the secondary storage tank to regulate the flow of sludge. By opening the valve, the sludge moves to the cylinder. Here, the piston compress the sludge and remove water from it is extracted through the fine wire mesh at the end of the cylinder which is stored in the water tank. Water tank consist of two sections- section 1 and section 2.

When the water in the section-1 is filled up, it overflows and collects in the section-2. In section-2, a pipe is provided through which the water is drawn out for further filtration and purification process after which it can be reused for domestic purposes.

The water in the section-1 is used for adding water content to the sludge so as to enable it to pass smoothly through the wire mesh. This is accomplished by using spray nozzle in which water is pumped using submerged water pump.

After compression and removal of water from the sludge in the compressing unit of the system, a semi-solid cake is formed which is extracted through the sludge gate provide underneath the cylinder. The sludge cake is then dumped in the composting box under controlled factors of temperature, pressure etc.

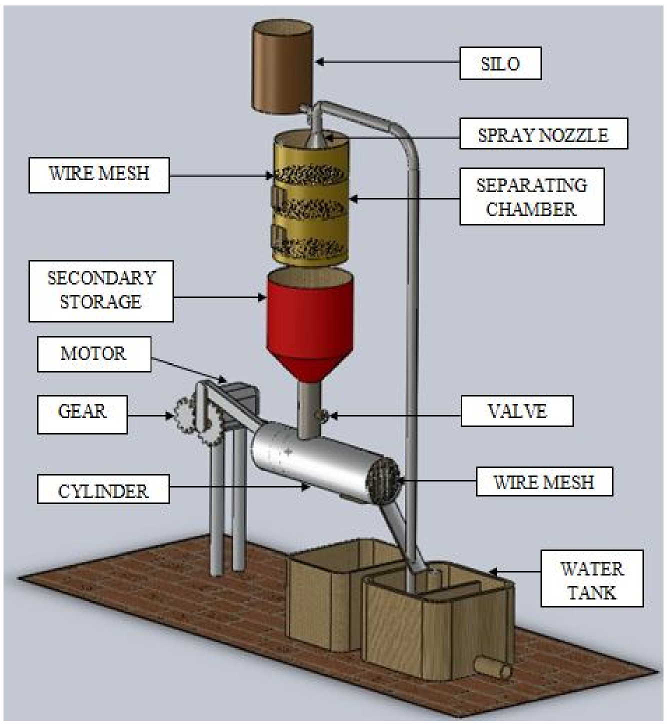

Figure-2 Sludge treatment system

IV. CONCLUSION

Sludge is a semi-solid slurry which is a mixture of solid components and water content of 40% -60 %.Sludge is the most contaminated component that is discarded in the water bodies like river through the sewage pipelines causing pollution of water bodies and ground water which is serious concern for the society. As sludge contains microorganisms, pathogen which when enter human body can cause serious ailments like hepatitis, jaundice, cancer, etc. Discarding of sludge in open space in improper manner can cause environmental pollution as it has a very filthy smell which attracts houseflies and other microorganisms to grow and can pollute air, thereby causing air-borne disease. So, this drawback of the sludge can be converted into boon if the sludge is treated in a most efficient manner. For this, there is a need of a proper system that can be treat the sludge and can extract useful product that can be beneficial for the society. So, we have designed a system that will treat the sludge in the most effective way thereby nullifying each drawbacks and turning it into a boon for the society. Hence, we propose a system called 'sludge treatment system' which can overcome the following harmful factors mention below:

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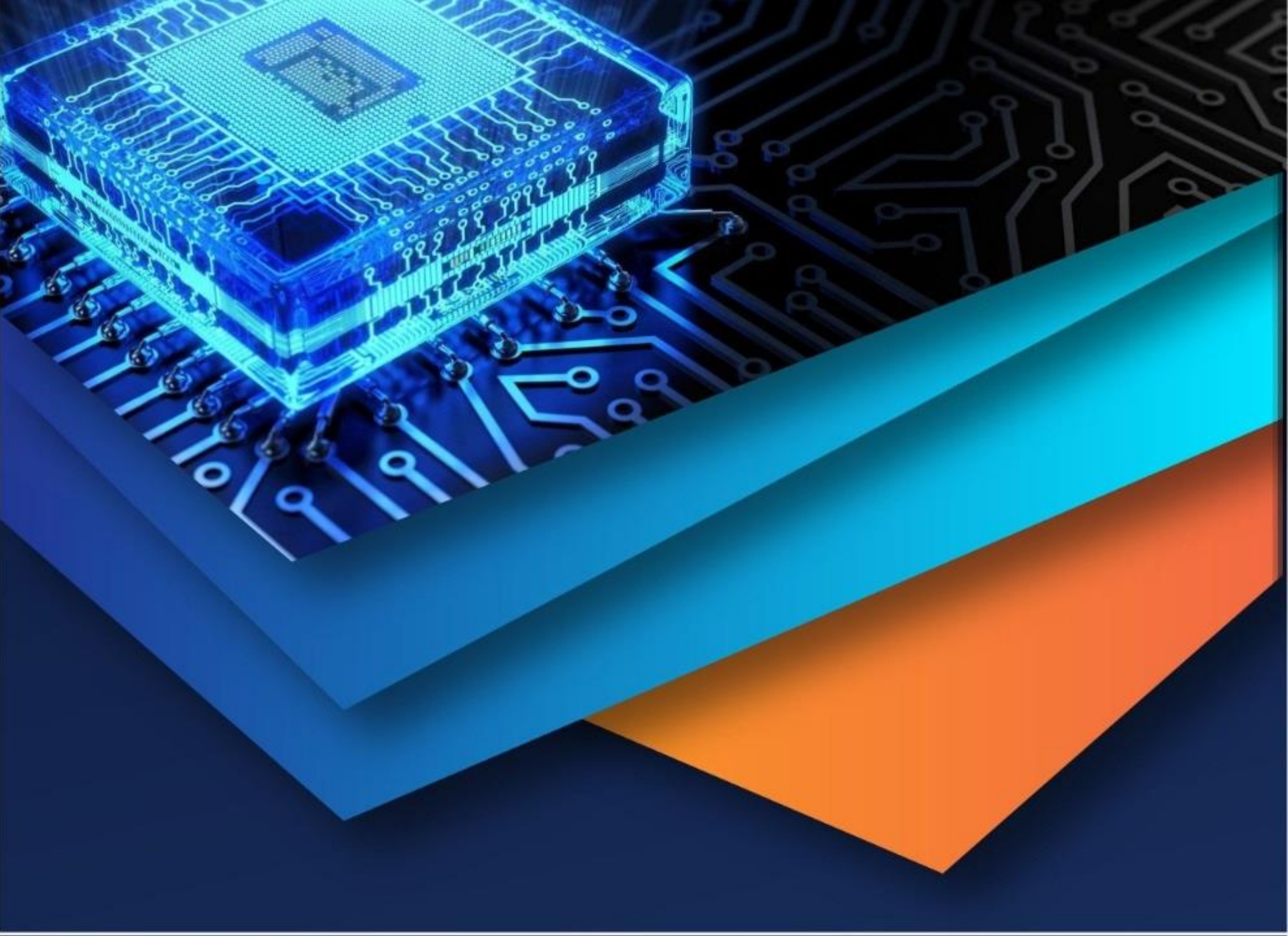
A. To reduce the pollution of fresh water bodies.
B. To derive the most fertile organic manure.
C. To extract the water from the sludge that can be reused after the series of filtration and purification process.

REFRENCES

[1] Amol shroff , " Designing of Silo in Batching System", International Journal of Emerging Engineering Research and Technology Volume 3, Issue 3, March 2015, PP 6-12 ISSN 2349-4395 (Print) & ISSN 2349-4409 (Online).
[2] Bien J., Neczaj E., Milczarek M. 2013 "Co-composting of meat packing wastewater sludge and organic fraction of municipal solid waste",Global NIEST Journal, Vol 15, No-4, 513
[3] B.Shoba "Utilization of Water Treatment Plant Sludge in the Brick Manufacturing",The International Journal of Science & Technoledge(ISSN 2321-919X).
[4] Chunbao (Charles) Xu, Jody Lancaster , "Treatment of Secondary Sludge for Energy Recovery",Department of Chemical Engineering, Lakehead University, 955 Oliver Road, Thunder Bay, Ont., Canada P7B 5E1
[5] Claudia Bruna Rizzardini and Daniele Goi " Sustainability of Domestic Sewage Sludge Disposal" ,Sustainability 2014, 6, 2424-2434; doi:10.3390/s sustainability ISSN 2071-1050.
[6] "Jet nozzles, Type DUK" from TROX company, retrieved 15th October 2013 from http://www.troxaustralia.com/xpool/download/en/technicaldocuments/diffusers/leaflets/tduk.pdf
[7] GFC Rogers, and Cohen, H. Gas Turbine Theory, p.108 (5th Edition), HIH Saravanamuttoo.
[8] Synthetic woven wire mesh Information on polyester and polypropylene wire cloth
[9] Simulation of Thermal-Mechanical Strength for Marine Engine Piston Using FEA Journal of Engineering Research and Applications www.ijera.com ISSN : 2248-9622, Vol. 4, Issue 3(Version 1),by Elijah Musango Munyao, Jiang Guo He, Yang Zhiyuan, Zou Xiang Yi .
[10] Design Data Handbook (In SI and Metric Units) For Mechanical Engineers K.Mahadevan / K. Balveera Reddy.Published by CBS Publisher & Distributors P Ltd
[11] A Textbook of Machine Design (S.I. UNITS) [A Textbook for the Students of B.E. / B.Tech., U.P.S.C. (Engg. Services); Section 'B' of A.M.I.E. (I)] by R.S. KHURMI J.K. GUPTA 2005 EURASIA PUBLISHING HOUSE (PVT.) LTD. RAM NAGAR, NEW DELHI-110 055.



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