Design And Fabrication Of Machine For Removal Of Salt Formation In Borewell Pipeline


Abstract: In day to day activity, regularly in-house utility of pipes are used which made up of High Density Polyethylene (HDPE). While sucking and flow through the water from underground to some other specified destination depending upon our home utilizes and agricultural irrigation purposes. Ground water which contains such amount of salts, continuously passage of ground water through pipelines there is chance for the deposition of salts inside the surface of pipe. If the process continues over a period of time, results in decreasing of inner surface diameter which leads to arrest the free flow of water through the pipeline. Finally it may cause damage to pipes such as occurrence of corrosion and even tends to break/crack in pipe surface. Mainly, the scale deposition contains the composition of calcite which is formed from calcium carbonate occurs in water. In general, hydrochloric acids are used to remove the salt deposition. Because of this process the pipe strength and also lifetime of the pipe deviates from originality due to chemical reaction takes place. So, we fabricate the machine for remove the scale by give pressure on the outside surface of pipe without any break/crack in pipe surface. In this method there is no need for any chemicals like hydrochloric acid

Keywords: Ac Motor, Borewell, HDPE Pipe, Lead screw, Pipe cleaning, Rollers, Scale formation.

1. INTRODUCTION

Scale is the well-known crusty chalky build up that forms when hard water is being processed in heat transfer equipment, such as, borewell pipe, heat exchangers, condensers, evaporators, cooling towers, boilers, pipe walls, as well as, household appliances. Scale composition differs from application to application depending on the mineral content of the utilized water. The most common component of scale though is calcium carbonate (CaCO₃), which occurs naturally as an ingredient of chalk, limestone, and marble. When hard water is pumped into heat transfer equipment, calcium and bicarbonate ions precipitate due to the changes in solubility, forming hard deposits (lime scale) on the heat transfer surfaces, clogging pipes and manifolds (Reaction (1)); a phenomenon traditionally called “fouling”.

\[ Ca^{2+} + 2HCO_3^- \rightarrow CaCO_3(s) + H_2O + CO_2(g) \]

Fouling problems are of major concern to many industries and agricultural wells. Once scale forms on a heat transfer surface, at least two major problems associated with the scale occur. The first problem is change in internal diameter of pipeline, substantially increases the pressure drop across the water piping system and the second problem is reduction of flow rate. The productivity decrease due to increasing production downtime while equipment is repaired and maintained, equipment failure or even total damage.

2 METHODOLOGY

The methodology of this research work has been depicted in Fig. 1.
3 MATERIALS AND SPECIFICATIONS

Table 1 Shows the Materials and its Specifications

<table>
<thead>
<tr>
<th>COMPONENTS</th>
<th>MATERIALS</th>
<th>PICTURES</th>
<th>SPECIFICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC Motor</td>
<td>Cast Iron</td>
<td><img src="image1.png" alt="AC Motor" /></td>
<td>Power=1/4 HP, Speed=1200 rpm</td>
</tr>
<tr>
<td>Spur Gear</td>
<td>Mild Steel</td>
<td><img src="image2.png" alt="Spur Gear" /></td>
<td>No of teeth=60, Count =3</td>
</tr>
<tr>
<td>Frame</td>
<td>Mild Steel</td>
<td><img src="image3.png" alt="Frame" /></td>
<td>Square Rod 4cm*4cm</td>
</tr>
<tr>
<td>Shaft</td>
<td>Mild Steel</td>
<td><img src="image4.png" alt="Shaft" /></td>
<td>Dia=1.2cm</td>
</tr>
<tr>
<td>Bearing</td>
<td>Stainless Steel</td>
<td><img src="image5.png" alt="Bearing" /></td>
<td>ID=12mm, OD=37mm</td>
</tr>
<tr>
<td>Roller</td>
<td>Mild Steel</td>
<td><img src="image6.png" alt="Roller" /></td>
<td>Dia=60mm</td>
</tr>
<tr>
<td>Hand Leaver</td>
<td>Mild Steel</td>
<td><img src="image7.png" alt="Hand Leaver" /></td>
<td>As Required</td>
</tr>
<tr>
<td>Lead Screw</td>
<td>Mild Steel</td>
<td><img src="image8.png" alt="Lead Screw" /></td>
<td>Length=1m, Dia=12mm, Count =2</td>
</tr>
<tr>
<td>Belt</td>
<td>Rubber</td>
<td><img src="image9.png" alt="Belt" /></td>
<td>V-Belt, Count =1</td>
</tr>
<tr>
<td>Pulley</td>
<td>Mild Steel</td>
<td><img src="image10.png" alt="Pulley" /></td>
<td>Dia=16cm</td>
</tr>
</tbody>
</table>

Dia. Of driver=4
Dia. Of driven=16
Driven rpm2=D2/D1=rpm1/rpm2
=16/4=1200/rpm2=300rpm

4 DESIGN

4.1 Design Calculation
Fig 2 represents the proposed design of the project. With the help of this design further calculations and designs are made.

1. Torque of AC motor used,
   Where, \( P = \frac{(2\pi N T)}{60} \)
   \( T = \frac{(P \times 60)}{(2\pi N)} \)
   \( P = 200W, N = 1200\) rpm
   \( T = \frac{(200 \times 60)}{(2 \times 3.14 \times 1200)} \)
   \( T = 1.59Nm \)

2. Pulley rpm,
   Driver rpm1=1200

4.2 Design Analysis
Design Process can be carried out by different software such as Autocad, SolidWorks, Proe, Creo, etc.. The design process was done entirely by using the SOLID WORKS Software. This software was selected as it is more user friendly and most common software for solid modeling.

![Proposed Design](image11.png)
5 PROPOSED SYSTEM
The base frame which acts a bed of machine is fabricated with the help of square tubes and channels by metal cutting and metal joining process called welding. The roller which is supported by bearing at its ends is mounted to the base frame and one end of roller shaft is coupled with larger pulley which is connected with AC drive with the help of belt. Another roller is mounted parallel to the static roller and get connected to the height adjustment mechanism. The height adjustment mechanism consists of pair of lead screw which is supported by bearing ends, its top end is mounted with two large diameter spur gear and this two gears get meshed with single pinion gear which get attached with hand lever. The nut meshed with lead screw is attached with dynamic roller such that the rotation of lead screw tends to adjust the position of roller.

6 WORKING
Initially the dynamic roller is adjusted by rotating the hand lever either by clock wise or counter clock wise, this rotation...
tends to rotate the pinion gear and causes the lead screw to rotate with the help of interconnected spur gears. The rotation of lead screw makes nut meshed with it to move linearly towards top or bottom as per the rotation experienced. Once the required gap is achieved pipe in which scales has to be removed is placed inside the gap and AC motor is turned on, it tends to rotate the static roller which is connected with the help of belt drive. This rotation crushes the loaded pipe and makes the scale layer to break and loose its structure, by continuing the process complete scale layer is removed from the pipe.

7 CONCLUSION
The main motive of the project is to remove the salt layer formation in pipeline. It focuses on small, medium and large scale agriculture and industries to reuse and recycle of plastic. By application of this technology, we have assembled such a machine which has being cost effective at the same time. The low budget project is very useful for the society and being low cost and energy efficient that plays a vital role in environment.

REFERENCES