WATER PUMPING SYSTEM FOR INUNDATED AGRICULTURAL FIELDS

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ABSTRACT

It is well known phenomenon that lakhs of agricultural crops go waste because of floods, due to excess rains. Keeping the above thing in mind, in this paper an attempt has been made to fabricate a system to pump flooded slurry water from inundated agricultural fields. Centrifugal pumps are utilized to serve this purpose. The layout of the mounting of pumps and drive from engine is described in detail. The proposed system can pump out water at a rate of 96000 Liters/hr. The two pumps will be driven simultaneously by tapping power from propeller shaft of a tractor with the help of V-belt drive. A prototype has been made as per the proposed system.

Key words: Mounting frame, Centrifugal pump, V- Belt drives.

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1. INTRODUCTION

India’s unseasonal rains are causing a huge damage to Rabi crops. States such as Uttar Pradesh, Maharashtra, Haryana, Punjab, and Rajasthan are likely to be more hit with damages in a wide variety of crops such as Potato, Mustard, Bengal Gram, wheat etc. Fruit crops such as Oranges, Pomegranate, Grapes, Mangoes are more hit compared to other fruits. All these crop damages could possibly lead to decrease in productivity of these crops, and hence reduction in production both quality as well as quantity. Government of India (GOI) is thinking of some steps which can be helpful to farmers in their hard times.

According to the GOI estimates, in 2014-15 total crop production stood at 25.70 crore tones, which is about 3% less than the previous year (2013-14) production of 26.55 crore tones. According to a reputed agricultural research institution, most of the pulses which were at harvesting stage, damaged due to these untimely rains which played havoc in reducing the production of these crops. So, these rains will play a pivotal role in reducing the yields of some major crops such as Mustard, Bengal gram, Black gram etc., which may ultimately lead to a spike in prices of these crops. Excess rains lead to more damage. In general heavy and
untimely rains causing damage to the agricultural fields leading to a fall in economic growth across the countries. Some of the existing water pumping systems are shown in Fig. 1.

**Figure 1(a)** Doctor’s water pump  

**Fig. 1(b)** Pumping system by the box

**Figure 1(c)** Model of stator driven pump  

**Figure 1** Water pumping system

From the literature it can be concluded that the existing methodologies incorporate the accessories like couplings, connecting rod and other supporting structures.

The proposed system can be fixed to the tractor easily by means of bolts and nuts and can be conveniently mounted on a tractor with ease and in less time, to pump the water at any desired location.

### 2. PUMP AND BELT SPECIFICATIONS

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Suction Delivery Size</td>
<td>3 X 3 (inch X inch)</td>
</tr>
<tr>
<td>Head Range</td>
<td>16 m</td>
</tr>
<tr>
<td>Weight</td>
<td>14 kgf</td>
</tr>
<tr>
<td>Power</td>
<td>4 (HP)</td>
</tr>
<tr>
<td>RPM</td>
<td>3000</td>
</tr>
<tr>
<td>Cross-section symbol</td>
<td>B</td>
</tr>
<tr>
<td>Width of Cross-section at the top</td>
<td>17 mm</td>
</tr>
</tbody>
</table>

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editor@iaeme.com
Height of Cross-section : 11 mm
Belt included angle : 40°
Pitch length of Belt : 767 mm

The selected V-Belt is shown in Fig. 2 and Fig. 3 shows the pictorial view of driver and driven pulley.

Figure 2 Standard V-belt dimension

Figure 3 Driver and driven pulley

The selected belt is shown in Fig. 4

Figure 4 V belt
The belt drive assembly is presented in Fig. 5

![Belt Drive Assembly](image)

**Figure 5** Belt Drive Assembly

### 3. ASSEMBLED VIEW

The layout of pump set in tune with the propeller shaft is shown in Fig. 6

![Line diagram of proposed system](image)

**Figure 6** Line diagram of proposed system

Fig. 7 represent the proposed assembly

- Two pumps which are fixed bolted to the mounting frame
- The tractor output shaft having pulley with 2 V-grooves
- V Belt drives

Two pumps are coupled to the tractor output shaft having pulley with 2 grooves by means of V-Belt drives. These two pumps are placed behind the driver seat on a mounting frame which is dynamically balanced. The two pumps will be driven simultaneously by tapping power from propeller shaft with the help of V-Belt drive. Pump delivery head is connected to storage tank through pipes.
4. MODELLING AND ANALYSIS OF MOUNTING FRAME

Computer Aided Three dimensional Interactive Application (CATIA) is used for the modelling of mounting frame. The stress analysis is done in Ansys 12.1 work bench by applying equally 16 kgf load on both sides of the mounting frame.

The meshing of mounting frame is done as shown in Fig. 8

![Figure 8(a) Meshing of mounting frame](image-url)

![Figure 8(b) Constraining of Fixed support](image-url)
5. RESULTS

The following results are obtained after solving the model. As per the loading conditions and the design stress, the factor of safety is 15. The result is analysed by ANSYS V12.1 as presented in Fig. 9(a).

The total deformation of the mounting frame by the application of 16 kgf load is $8.2137 \times 10^5$ and the result is shown in Fig. 9(b).
Figure 9(b) Total Deformation of mounting frame

Vonmises stress represent the stresses in all directions. The vonmises stress of the mounting frame is $3.056 \times 10^{-6}$ maximum at the ends as given in Fig. 9(c).

Figure 9(c) Equivalent Elastic Stress

Figure 9 Analysis of frame

6. PROTOTYPE MODELING AND FABRICATION

Fig. 10 Shows prototype model. Pumps, simultaneously tap power from the prime mover of tractor Engine by means of V-belt drive.
7. CONCLUSIONS
In this paper, the focus had been made on to pump flooded slurry water from inundated agricultural fields. Centrifugal pumps are utilized to serve this purpose. The layout of the mounting of pump and drive from engine axle is described in detail. The mechanism of the system is fabricated to pump out water at the rate of 96000 liters/hr. The results of the FEA are satisfactory as maximum deformation is 3.05*10^-5 mm which is negligible and FOS is 15 and maximum Vonmisses stresses are absorbed to be 3.056e-6. The two pumps are driven simultaneously by tapping power from propeller shaft with the help of V-belt drive. A prototype is made as per the proposed model.

REFERENCES