THE INFLUENCE OF PTO (POWER TAKE OFF) SPEED ON PRESSURE AND FLOW VARIATION ON THE SPRAYING MACHINES

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Abstract. For a proper operation the spraying machines must be tested to establish the parameters for pumps. These papers are presented the results of a test on a piston pump, mounted on the EEP-600 ME spraying machine. It is also shown how the pump flow is modified when the rotation of the PTO and the working pressure are modified. The test results showed us that the change of the PTO rotation influence mostly the pump flow. The pressure influences slightly the pump flow.

Keywords: membrane and piston pumps, flow, pressure, testing equipment, spraying machines

INTRODUCTION

The pumps attached on the spraying machines have an important role in the working process in order to increase the pressure to assured the optimum pulverization, the agitation inside the tank and the refill of the tank. The principal pump types used for spraying machines are: membrane and piston pumps (mostly used on the spraying machines), piston pumps, membrane pumps, reel pumps, centrifugal pumps. The advantages of using these types of pumps are following: high pressures (some pumps up to 50 bars); spraying solution does not come in direct contact with the pistons; the assemble off-centred-piston does not wear because it is merged in oil; easy maintenance and low acquisition cost. Overall, spraying machines work correct if the pump delivers the right flow for the nozzles (at a certain pressure) and in the same times the necessary flow for agitation and homogenization of the solution inside the tank. The equation to determine the flow rate of the pumps is based to the next equation:

\[
Q_p = (q_d \cdot n_d) + (V_r \cdot k)
\]

Where: \(Q_p\) = necessary flow rate; \(q_d\) = maximum nozzle flow; \(n_d\) = number of nozzles; \(V_r\) = tank volume; \(k\) = percent coefficient which indicates the necessary flow rate for agitation. Some FAO recommendations states that the flow rate must assure the optimum functionality for the nozzles at maximum pressure and in the same time to have a 20% reserve necessary to for a good agitation.

MATERIAL AND METHOD

For experiences, was used a Herbst equipment pump. The main parts of this equipment are illustrated in figure 1.
The working principle was next: the flow coming from the pump gets inside the equipment through a quick coupling valve. The liquid is cleaned by the filter. Pressure and flow rate are measured by the pressure sensor and flow meter. The data are shown on the computer display and stored in the internal memory. Afterwards the data is sent to a desktop computer for analyzing (wireless). The maximum pressure valve assures that the pressure do not exceed 10 bar.

The PTO rotation is measured by the tachometer, shown in figure 2. In the research, the pump we used was IMOVILI D82. The objectives of the experiments were: establishment of the flow rate variation depending on the PTO rotation and pressure. The method we used was as follows: the hose from the outtake of the pomp was connected to the quick coupling. The measurements were made at 300, 350, 400, 450, 500 and 550 rotation of the PTO shaft.

**RESULTS AND DISCUSSION**

In order to determine the flow rate depending of the rotation and pressure, the measurements were taken at 2, 4, 6 and 8 bar pressure and 400 and 500 rotation of the PTO shaft. The experience results are shown in table 1.
### Table 1

<table>
<thead>
<tr>
<th>Rotation (rot/min)</th>
<th>Flow (l/min)</th>
<th>Pressure (bar)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 x 100</td>
<td>42.4</td>
<td>2</td>
</tr>
<tr>
<td>3.5 x 100</td>
<td>48</td>
<td>2.3</td>
</tr>
<tr>
<td>4 x 100</td>
<td>51.4</td>
<td>3</td>
</tr>
<tr>
<td>4.5 x 100</td>
<td>55.6</td>
<td>5</td>
</tr>
<tr>
<td>5 x 100</td>
<td>64.9</td>
<td>7</td>
</tr>
<tr>
<td>5.5 x 100</td>
<td>75.2</td>
<td>8</td>
</tr>
</tbody>
</table>

The variation parameters from table 1 are shown in figure 3.

![Figure 3. The measured variation parameters](image)

The variation of the flow rate depending on the PTO shaft rotation is shown in figure 4.

![Figure 4. The results of the tests regarding the dependencies between flow rate and PTO shaft](image)
The diagram show that among with the increasing of the PTO shaft rotation the flow rate increase also. This fact is important because in order to have a constant nozzle pressure and constant overall flow rate there must be constant PTO shaft rotation.

![Diagram showing flow rate increase with PTO shaft rotation](image)

Fig. 5. The results of the tests regarding the dependencies between flow rate and pressure

The variation of the flow rate along with the pressure can be observed in figure 5. Analyzing the figure 5, a constant PTO shaft rotation, the flow rate decrease a little bit when the pressure is rising. This decrease is more accentuated at a higher PTO shaft rotation. We can say that the pressure does not influence mostly the flow rate. The flow rate is changed significant when the PTO shaft rotation is changing.

**CONCLUSIONS**

The membrane and piston pumps are indicated to use on the spraying machines. The flow rate of these pumps is influenced mostly by the PTO shaft speed. Increasing the working pressure, for the membrane and piston pumps, influences slightly the variation of flow rate if the PTO shaft speed is kept constant.

**REFERENCES**