ABSTRACT

This work comprises a study of the behavior of a removal chamber with a progressive increase in feed vegetal mass of a constant initial extraneous matter composition; a repetition of some of the previous tests using another composition so as to establish a comparison of the results obtained; a study of the possibility of affecting chamber performance as a result of variations in the deviation of expelled extraneous matter; and, finally, a review of the behavior of response indicators when the revolutions of the axial fan are increased.

The results obtained led to new criteria regarding the dimensions of future harvester removal chamber as well as to a possible moving of propeller location nearer the scattering area of vegetal mass, and a likely reduction in axial fan power consumption.

INTRODUCTION

As a result of a research work carried out during 1976 on an extraneous matter removal system by suction at a test bench scale, among other conclusions arrived at, it was established that the removal chamber used was overdimensioned. Therefore, a recommendation was made to undertake a new study to investigate this matter.

A study was prepared which would involve: 1) behavior of the chamber with a progressive increase in vegetal mass feeding and a constant composition of initial extraneous matter; 2) repetition of some of the tests mentioned in paragraph (1) but using a different initial composition; 3) possible effect of a higher or lower deviation of expelled extraneous matter on chamber performance; and 4) behavior of response indicators with an increase in the revolutions of the axial fan propeller.

MATERIALS AND METHODS

Experimental design

The cane harvesters used in Cuba normally operate on green cane with a
feeding mean load of 14 kg of clean cane (19.4 kg of vegetal mass with 26% of extraneous matter). This does not mean that for different reasons such as: adequate agricultural yields, erect varieties, well prepared fields, etc., they could not process feed rates slightly higher than mentioned above.

Due to these considerations it was decided to test the performance of the pneumatic removal chamber of the harvester with feeds increased up to a maximum which was approximately double the highest values attained in the field under operating conditions, and to quantify the behavior of the facility in the customary study indicators, including also in this case power consumption by the axial fan rotor.

Experiments were designed for intervals of 4 up to 40 kg of vegetal mass feeding. Ten experimental points or runs were carried out with two repetitions of each one. Table 1 shows the weights in kilograms to be distributed on the feeding apron of the set up (Fig. 1) partial weights of each one of the components which make up a vegetal mass containing in every case 28% of initial extraneous matter.

![Figure 1. Experimental set-up](image)

Table 2 shows the partial and total weights of the different vegetal mass components, but this time with 21% extraneous matter.

Various experiments were made varying the width of the deviation spiral of extraneous matter at its outlet to the exterior as well as to verify power consumption by the chamber by increasing the rotation speed of the axial fan propeller.
TABLE 1. Distribution of vegetal mass in weight according to feed mass in Kg/sec for an initial extraneous matter composition of 28%.

<table>
<thead>
<tr>
<th>Corrida</th>
<th>Alimentación Kg/s</th>
<th>Masa Total Kg</th>
<th>Cana Limpia kg</th>
<th>Tallo Verde kg</th>
<th>Pena Chica kg</th>
<th>Hojas Verdes kg</th>
<th>Hojas Secas kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4</td>
<td>9.5</td>
<td>6.8</td>
<td>0.7</td>
<td>0.4</td>
<td>0.9</td>
<td>0.7</td>
</tr>
<tr>
<td>2</td>
<td>8</td>
<td>18.9</td>
<td>13.6</td>
<td>1.4</td>
<td>0.8</td>
<td>1.8</td>
<td>1.3</td>
</tr>
<tr>
<td>3</td>
<td>12</td>
<td>28.6</td>
<td>20.6</td>
<td>2.1</td>
<td>1.2</td>
<td>2.7</td>
<td>2.0</td>
</tr>
<tr>
<td>4</td>
<td>16</td>
<td>38.2</td>
<td>27.6</td>
<td>2.8</td>
<td>1.6</td>
<td>3.6</td>
<td>2.7</td>
</tr>
<tr>
<td>5</td>
<td>20</td>
<td>47.5</td>
<td>34.2</td>
<td>3.5</td>
<td>2.0</td>
<td>4.5</td>
<td>3.3</td>
</tr>
<tr>
<td>6</td>
<td>24</td>
<td>57.1</td>
<td>41.1</td>
<td>4.2</td>
<td>2.4</td>
<td>5.4</td>
<td>4.0</td>
</tr>
<tr>
<td>7</td>
<td>28</td>
<td>66.7</td>
<td>48.0</td>
<td>4.9</td>
<td>2.8</td>
<td>6.3</td>
<td>4.7</td>
</tr>
<tr>
<td>8</td>
<td>32</td>
<td>76.1</td>
<td>54.8</td>
<td>5.6</td>
<td>3.2</td>
<td>7.2</td>
<td>5.3</td>
</tr>
<tr>
<td>9</td>
<td>36</td>
<td>86.7</td>
<td>61.7</td>
<td>6.3</td>
<td>3.6</td>
<td>8.1</td>
<td>6.0</td>
</tr>
<tr>
<td>10</td>
<td>40</td>
<td>95.3</td>
<td>68.6</td>
<td>7.0</td>
<td>4.0</td>
<td>9.0</td>
<td>6.7</td>
</tr>
</tbody>
</table>

TABLE 2. Distribution of vegetal mass in weight according to feed mass in Kg/sec for an initial estraneous matter composition of 21%.

<table>
<thead>
<tr>
<th>Run</th>
<th>Feed kg/sec</th>
<th>Total Mass kg</th>
<th>Clean Cane kg</th>
<th>Green Stalks kg</th>
<th>Tops kg</th>
<th>Green Leaves kg</th>
<th>Dry Leaves kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>8</td>
<td>18.9</td>
<td>15.0</td>
<td>0.9</td>
<td>0.5</td>
<td>1.2</td>
<td>1.3</td>
</tr>
<tr>
<td>12</td>
<td>24</td>
<td>57.1</td>
<td>45.1</td>
<td>2.8</td>
<td>1.6</td>
<td>3.6</td>
<td>4.0</td>
</tr>
<tr>
<td>13</td>
<td>40</td>
<td>95.3</td>
<td>75.2</td>
<td>4.7</td>
<td>2.7</td>
<td>6.0</td>
<td>6.7</td>
</tr>
</tbody>
</table>

The differences in absolute percentages of the two morphological compositions used are shown in Table 3.

TABLE 3. Differences in absolute percentages of the two morphological compositions.

<table>
<thead>
<tr>
<th>Clean Cane</th>
<th>Extraneous Matter Stalks</th>
<th>Extraneous Matter Tops</th>
<th>Extraneous Matter Green Leaves</th>
<th>Trash</th>
</tr>
</thead>
<tbody>
<tr>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>72.0</td>
<td>28.0</td>
<td>7.4</td>
<td>4.2</td>
<td>9.4</td>
</tr>
<tr>
<td>79.0</td>
<td>21.0</td>
<td>4.9</td>
<td>2.9</td>
<td>6.2</td>
</tr>
</tbody>
</table>
Equipment used and their characteristics

A Libertadora 1200-B harvester was used for this study as a facility at a test bench scale. The front part of the machine which enclosed the bottom cutting elements and the chopper, among other things, was removed and substituted with a 5 meter long feeding apron with a linear speed of 2.1 m/sec and driven by a 2.8 kw electric motor.

Vegetal mass fell onto the feeding apron in the amounts programmed by Tables 1 and 2. The mass was suitably chopped so as to simulate the actual work of the bottom cutting element and the chopper under operating conditions.

Power consumption and the revolutions of the pneumatic chamber propeller were measured using:

1 - 8AH7M amplifier,
1 - H-700 oscillograph,
1 - mercury collector and
1 - inductive revolution counter

Tensometric sensors were sembridge mounted on the axis of the axial fan and the oscillograph was set at a speed of 16 cm of paper per second, recording for approximately 10 to 15 seconds. The driving axis of the propeller was calibrated by three repetitions under load and without load before being mounted on the machine. There was a variation of 10% of its nominal load at each step, Carm3.

Response Indicators

The facility responses studied were obtained by the following relations:

\[
ME = \frac{ME_f}{CL_f + ME_f} \times 100
\]

\[
E = \frac{ME_o - ME_f}{ME_o} \times 100
\]

\[
P = \frac{CL_o - CL_f}{CL_o} \times 100
\]

\[
N = \frac{M_n}{716.2}
\]

where:

\(ME\) = Residual impurities or extraneous matter not separated by the removal chamber

\(E\) = Extraneous matter removal efficiency of the pneumatic chamber
U. A. Peralta Abreu and L. E. Abreu

\[ P = \text{Clean cane losses due to removal operation} \]
\[ \text{ME}_0 = \text{Initial extraneous matter of feed vegetal mass} \]
\[ \text{ME}_f = \text{Final extraneous matter} \]
\[ \text{CL}_0 = \text{Initial clean canes in feed vegetal mass} \]
\[ \text{CL}_f = \text{Final clean canes after they have undergone the cleaning process in the removal chamber} \]
\[ M = \text{Torque measured on the axial fan driving axis} \]
\[ n = \text{Revolutions per minute of the axial fan axis} \]
\[ N = \text{Power consumed by the axial fan} \]

**RESULTS**

Tables 4 and 5 show the results obtained from the designs proposed in Tables 1 and 2. The data were corrected for the actual amount of feed processed by the removal chamber as a result of losses occurred on the longitudinal conveyor of the harvest due to a fault in the mounting of the spreader drum. These tables also show the effective revolutions of the fan propeller, power consumption, and the three characteristic response indicators for the evaluation of cane harvesters measured in their mean values. Runs were satisfactorily carried out (Peralta Abreu).

**TABLE 4. Results obtained from designs proposed in Tables 1 and 2**

<table>
<thead>
<tr>
<th>Corrida No.</th>
<th>Alimentacion Real kg/s</th>
<th>Rotacion Helice rpm</th>
<th>Potencia Consumida hp</th>
<th>Impurezas Residuales %</th>
<th>Eficiencia Camara %</th>
<th>Perdidas de cana %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3.2</td>
<td>1.185</td>
<td>45.60</td>
<td>14.8</td>
<td>56.9</td>
<td>1.5</td>
</tr>
<tr>
<td>2</td>
<td>6.4</td>
<td>1.176</td>
<td>47.86</td>
<td>15.1</td>
<td>56.1</td>
<td>1.6</td>
</tr>
<tr>
<td>3</td>
<td>9.8</td>
<td>1.131</td>
<td>47.37</td>
<td>16.3</td>
<td>52.6</td>
<td>0.3</td>
</tr>
<tr>
<td>4</td>
<td>13.1</td>
<td>1.176</td>
<td>51.8</td>
<td>15.8</td>
<td>53.7</td>
<td>0.2</td>
</tr>
<tr>
<td>5</td>
<td>16.8</td>
<td>1.194</td>
<td>53.34</td>
<td>14.8</td>
<td>54.5</td>
<td>0.5</td>
</tr>
<tr>
<td>6</td>
<td>19.6</td>
<td>1.164</td>
<td>54.77</td>
<td>16.4</td>
<td>52.7</td>
<td>0.0</td>
</tr>
<tr>
<td>7</td>
<td>23.6</td>
<td>1.188</td>
<td>60.04</td>
<td>16.5</td>
<td>50.6</td>
<td>1.6</td>
</tr>
<tr>
<td>8</td>
<td>27.1</td>
<td>1.146</td>
<td>57.60</td>
<td>15.8</td>
<td>52.3</td>
<td>1.1</td>
</tr>
<tr>
<td>9</td>
<td>30.1</td>
<td>1.158</td>
<td>60.63</td>
<td>16.4</td>
<td>51.5</td>
<td>0.5</td>
</tr>
<tr>
<td>10</td>
<td>33.2</td>
<td>1.170</td>
<td>59.95</td>
<td>16.8</td>
<td>50.6</td>
<td>0.6</td>
</tr>
</tbody>
</table>

The results of the increase in deviation spiral width and the results of the increase in propeller revolutions are shown in Table 6.

**DISCUSSION**

*Efficiency of the removal chamber*

From the results shown in Table 4 it may be seen that the chamber efficiency
TABLE 5. Results obtained from designs proposed in Tables 1 and 2

<table>
<thead>
<tr>
<th>Run No.</th>
<th>Actual Feed kg/sec</th>
<th>Propeller Rotation rpm</th>
<th>Power Consumption hp</th>
<th>Residual Impurities %</th>
<th>Chamber Efficiency %</th>
<th>Cane Losses %</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>7.5</td>
<td>1.200</td>
<td>46.57</td>
<td>10.0</td>
<td>58.6</td>
<td>0.0</td>
</tr>
<tr>
<td>12</td>
<td>22.9</td>
<td>1.188</td>
<td>53.90</td>
<td>10.8</td>
<td>56.4</td>
<td>0.2</td>
</tr>
<tr>
<td>13</td>
<td>37.9</td>
<td>1.176</td>
<td>57.46</td>
<td>11.2</td>
<td>55.2</td>
<td>0.9</td>
</tr>
</tbody>
</table>

TABLE 6. Results of the increase in deviation spiral with an increase in propeller revolutions.

<table>
<thead>
<tr>
<th>Item</th>
<th>Initial Extraneous Matter %</th>
<th>Actual Feed kg/sec</th>
<th>Propeller Rotation rpm</th>
<th>Power Consumption hp</th>
<th>Impurities %</th>
<th>Efficiency %</th>
<th>Losses %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wide Deflector</td>
<td>28</td>
<td>22.1</td>
<td>1.200</td>
<td>45.90</td>
<td>20.5</td>
<td>36.7</td>
<td>1.1</td>
</tr>
<tr>
<td>Propeller at 1300 rpm</td>
<td>21</td>
<td>22.9</td>
<td>1.287</td>
<td>66.00</td>
<td>10.2</td>
<td>59.6</td>
<td>0.6</td>
</tr>
<tr>
<td>Propeller at 1300 rpm</td>
<td>28</td>
<td>22.6</td>
<td>1.278</td>
<td>66.94</td>
<td>15.4</td>
<td>55.7</td>
<td>0.5</td>
</tr>
</tbody>
</table>

remains almost constant, with only a small tendency to decrease as feed is increased.

This result is illustrated in Fig. 2 where the minimum squares method was used.

If the vegetal mass led to the harvester were very long, the chamber efficiency would drop more or less sharply. However, it was found that the axial fan kept its performance pattern and was not affected by the load to which it was subjected, notwithstanding the fact that it had to handle more than double the mass that was normal in actual field operation.

By reducing the initial extraneous matter composition to 21% (Table 5) the efficiency increased slightly, as cane field impurities decreased with the same feed rate. This would be easily understood, since it was known that while cane field extraneous matter decrease, there was an increase in the specific weight of dry leaves in relation to total impurities. It was precisely here where pneumatic removal chambers were most efficient.

Fig. 1 shows the curve corresponding to the 21% composition and efficiency behaved similarly as the above where extraneous matter composition was 28%.
FIGURE 2. Efficiency of the removal chamber vs. productivity determined by minimum squares method.

FIGURE 3. Extraneous matter not separated by the removal chamber determined by minimum squares method.

Cane losses in the removal chamber

In all experimental runs (Tables 4, 5 and 6) cane losses remained within a very narrow scale of values. It was found that feed variations exerted no influence on this indicator. Although it has already been demonstrated in a previous work, it should be emphasized that a change in the composition of initial extraneous matter did not have any influence on losses due to the performance of this chamber.
Extraneous matter not separated by the removal chamber

The results of this response, which are shown in Tables 4 and 5, were processed by the minimum squares method and they appear on Fig. 3.

Fig. 3 shows that the quality of the harvest was maintained and that it was affected only very slightly by feed increases.

The different extraneous matter components were not studied separately in the mass received, but it should be pointed out that all the green stalk of the top and most of the top leaves were recovered without having been removed by the chamber.

By studying the data shown in Table 3 and Fig. 3 it is easy to demonstrate how any increase in initial extraneous matter would bring about a proportional increase in the impurities received from the harvester. The green stalks of the top and the top leaves in the initial mass were increased. The removal chamber was virtually unable to do an effective removal work on these two components, specially on the green stalks.

Power consumption by the axial fan

Fig. 4 shows the values resulting from power consumption (Table 4) due to feed increases for an initial extraneous matter composition of 28%.

![Graph showing power consumption](image)

**FIGURE 4.** Values resulting from power consumption due to feed increases for an initial extraneous matter composition of 28%.
From the data plotted in Fig. 4, it could be seen that in all the areas investigated no inflexion tendency of the curve toward lower power consumption values was appreciated. As feed rates were increased, the power requirements of the fan also increased by a ratio of 0.54 HP and 0.36 HP per kilogram of increase in feed mass for initial extraneous matter compositions of 28% and 21%, respectively.

It should be emphasized that these power consumption values per kilogram of increase in feed mass were by no means a generalized result as it applied only to the chamber studied herein and to the constructive condition at the time of the experiment.

Table 7 shows some of the data received which appear in Tables 1 and 4, knowing the feeding apron was 5 meters long and had a linear speed of 2.1 m/sec.

**TABLE 7.** Representation of results corresponding to tests made with 28% initial impurities

<table>
<thead>
<tr>
<th>Corrida No.</th>
<th>Caña Inicial kg/s</th>
<th>Perdidas en Caña %</th>
<th>Caña por Ventilad. kg/s</th>
<th>M.E. Inicial Kg/s</th>
<th>Efic. Camara %</th>
<th>M.E. por Ventilad. Kg/s</th>
<th>Total por Ventilad kg/s</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.3</td>
<td>1.5</td>
<td>0.036</td>
<td>0.9</td>
<td>56.9</td>
<td>0.512</td>
<td>0.547</td>
</tr>
<tr>
<td>2</td>
<td>4.6</td>
<td>0.3</td>
<td>0.014</td>
<td>1.8</td>
<td>56.1</td>
<td>1.010</td>
<td>1.024</td>
</tr>
<tr>
<td>3</td>
<td>7.1</td>
<td>0.3</td>
<td>0.021</td>
<td>2.7</td>
<td>52.6</td>
<td>1.420</td>
<td>1.441</td>
</tr>
<tr>
<td>4</td>
<td>9.4</td>
<td>0.2</td>
<td>0.019</td>
<td>3.7</td>
<td>53.7</td>
<td>1.987</td>
<td>2.006</td>
</tr>
<tr>
<td>5</td>
<td>12.1</td>
<td>0.5</td>
<td>0.061</td>
<td>4.7</td>
<td>54.5</td>
<td>2.562</td>
<td>2.623</td>
</tr>
<tr>
<td>6</td>
<td>14.1</td>
<td>0.0</td>
<td>0.000</td>
<td>5.5</td>
<td>52.7</td>
<td>2.898</td>
<td>2.898</td>
</tr>
<tr>
<td>7</td>
<td>17.0</td>
<td>1.6</td>
<td>0.272</td>
<td>6.6</td>
<td>50.6</td>
<td>3.340</td>
<td>3.612</td>
</tr>
<tr>
<td>8</td>
<td>19.5</td>
<td>1.1</td>
<td>0.215</td>
<td>7.6</td>
<td>52.3</td>
<td>3.975</td>
<td>4.190</td>
</tr>
<tr>
<td>9</td>
<td>21.7</td>
<td>0.5</td>
<td>0.109</td>
<td>8.4</td>
<td>51.5</td>
<td>4.326</td>
<td>4.435</td>
</tr>
<tr>
<td>10</td>
<td>23.9</td>
<td>0.6</td>
<td>0.143</td>
<td>9.3</td>
<td>50.6</td>
<td>4.706</td>
<td>4.849</td>
</tr>
</tbody>
</table>

Fig. 4 illustrates the curves for power consumption by the chamber, extraneous matter removed and clean cane losses by the axial fan propeller by unit of time, in each run made with an initial composition of 28%.

Each of the curves plotted in Fig. 5 were related to their particular scale and all of them were vertically related to the corresponding run number of the experiments.

It would be seen that the extraneous matter mass removed by the chamber increased almost constantly without undergoing any modification, which was expected since extraneous matter removal efficiency (Fig. 2) was almost constant and vegetal mass increase by run (Table 1) also showed a constant slope.

The most interesting characteristic which statistically explained the variations in power consumption was the clean cane loss curve caused by the cleaning processing. In almost every run where loss increases occurred, there were proportional increases in power consumption.
Based on the above experience, power consumption due to extraneous matters and for cleaning cane lost by the removal process could be calculated. By applying the minimum squares method to the relation between removed extraneous matter and power consumption, on the one hand and losses in each run, on the other, the following results were obtained.

\[
N = 43.66 + 3.24 \, m
\]

where:

- \( N \) = power
- \( m \) = mass of impurities per second which pass through the axial fan
- \( P \) = cane lost by the fan in a unit of time \( \frac{kg}{s} \)
- \( C \) = corresponding run

FIGURE 5. Curves for power consumption by chamber, extraneous matter removed and clean cane losses vs. number of runs.

The first equation demonstrates that for each kilogram by second of extraneous matter removed by the axial fan, power consumption increased by 3.24 hp (2.4 kW). If both relations were taken and results were obtained for the most significant cases (Table 7), it will be found that for each kilogram by second of clean cane lost through the axial fan propeller studied, power consumption increases above 8 hp (6 kW).

These results, specially the last one, should be accepted with reservation and be regarded only as examples. This matter should be studied further so as to arrive at accurate conclusions based on further data. However at present, it might be as-
certained that it is perfectly valid to assume that power consumption due to cane losses is higher than power consumption by an equivalent extraneous matter mass by unit of time.

Tables 8 and 9 show processed values corresponding to the results of tests made with 21% initial impurities and a comparison between these results and those for 28%.

**TABLE 8.** Processed values corresponding to the results of tests made with 21% impurities.

<table>
<thead>
<tr>
<th>Corrida No.</th>
<th>Caffa Initial kg/s</th>
<th>Perdidas en Caffa %</th>
<th>Caffa por Ventilad kg/s</th>
<th>ME Initial kg/s</th>
<th>Efic. Camara %</th>
<th>M.E. por Ventilad kg/s</th>
<th>Total por Ventilad kg/s</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>5.8</td>
<td>0.0</td>
<td>0.000</td>
<td>1.7</td>
<td>58.6</td>
<td>0.996</td>
<td>0.996</td>
</tr>
<tr>
<td>12</td>
<td>17.8</td>
<td>0.2</td>
<td>0.036</td>
<td>5.1</td>
<td>56.4</td>
<td>2.876</td>
<td>2.912</td>
</tr>
<tr>
<td>13</td>
<td>29.5</td>
<td>0.9</td>
<td>0.286</td>
<td>8.4</td>
<td>55.2</td>
<td>4.637</td>
<td>4.903</td>
</tr>
</tbody>
</table>

**TABLE 9.** Power specific consumption vs. feed mass

<table>
<thead>
<tr>
<th>Initial %</th>
<th>Ext. Matter 26%</th>
<th>Ext. Matter by fan 21%</th>
<th>Ext. Matter by fan 28%</th>
<th>Power Consumption 21%</th>
<th>Power Consumption 28%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.7</td>
<td>1.8</td>
<td>0.996</td>
<td>1.010</td>
<td>46.51</td>
<td>47.86</td>
</tr>
<tr>
<td>5.1</td>
<td>5.5</td>
<td>2.876</td>
<td>2.898</td>
<td>53.90</td>
<td>54.77</td>
</tr>
<tr>
<td>8.4</td>
<td>9.3</td>
<td>4.637</td>
<td>4.706</td>
<td>67.46</td>
<td>69.95</td>
</tr>
</tbody>
</table>

According to Table 9, power consumption for the tests carried out with 21% initial extraneous matter was lower than that for the tests made with 28% initial extraneous matter. This result corresponds to the respective masses that passed by the fan in each case and which also depended on the initial masses for each extraneous matter composition. It may be easily established that, under identical feeding conditions, as extraneous matter present in a cane field increase, the power required by the removal chamber would proportionately increase.

Gross power consumption, net specific consumption and effective power consumption indicator. The general power consumption by unit of mass feed per second was derived from the following relation:

$$C_{eg} = \frac{N}{q}$$

where:

- $C_{eg} =$ gross power consumption in hp–s/kg
- $N =$ power consumption in hp
- $q =$ vegetal mass feed by unit of time in kg/s
All the points obtained from the above equation have been plotted on Fig. 6 with data from Table 4 and 5, for the two initial compositions used.

\[ C'_{eq} = \frac{N}{q'} \]

where:

- \( C'_{eq} \) = gross specific power consumption per unit of mass removed
- \( q' \) = mass removed by the axial fan in a unit of time

As it can be seen in both figures, all points — regardless the morphological composition to which they may belong — were roughly plotted on the same curve. This indicated that the chamber that was studied through such indicators underwent the same variation, irrespective of feed vegetal mass changes; and these points showed the removal chamber performance patterns, provided chamber physical factors remain unchanged.

On the other hand, the net specific power consumption per unit of feed mass per second is given by the following relation:

\[ C'_{en} = \frac{N - Nx}{q'} \]

where:

- \( C'_{en} \) = net specific power consumption in hp-s/kg
- \( N \) = total power consumption
- \( Nx \) = power consumption under dry conditions
- \( q \) = vegetal mass feed rate in kg/s
**FIGURE 7.** Points corresponding to the global specific power consumption by unit of mass removed by second.

**FIGURE 8.** Points obtained for the net specific power consumption by second.

Fig. 8 shows the points obtained for the net specific power consumption per unit of mass feed power second. For 28% initial extraneous matter, the results were about 0.54 mean value, and that for 21% initial composition, the results were about 0.38 mean value.

The net specific power consumption per unit of mass removed per second through the axial fan is given by equation:

\[
\frac{C'_{en}}{kg} = \frac{N - Nx}{q'}
\]
FIGURE 9. Net specific power consumption per unit of feed mass by second.

where:

\[ C_{en} = \text{net specific power consumption} \]

\[ q' = \text{vegetal mass removed in a unit of time} \]

The results are shown in Fig. 9.

Where specific power consumption as related to mass feed rate (Fig. 8) is concerned, such consumption depended exclusively on the initial extraneous matter composition and that its value increased proportionally as impurities contained in the initial mass increase.

As expected, the indicator net specific power consumption, as related to the mass removed by the fan (Fig. 9), was influenced neither by a change in initial composition nor by a variation in feed. A consumption mean value obtained was 3.5 HP (2.6 kW) per gram of vegetal mass removed (extraneous matter + lost cane) per second.

Fig. 10 are plotted the curves corresponding to the indicator effective power consumption as related to feed mass indicator power consumption is expressed as:

\[ I_p = \frac{N - NX}{N} \times 100 \]
CONCLUSIONS

Cane losses which occurred during the removal process were not influenced by feed variations.

Power consumption by the chamber was directly proportional to initial extraneous matter composition.

Power consumption increased in a higher proportion with cane loss through the axial fan than with an equivalent mass of removed extraneous matter.

Effective power consumption for extraneous matter removal was very low in relation to total consumption: about 15% for feeds of the order of 16 to 20 kg/s.

A deviation in the flow of matter expelled by the axial fan provoked a reduction in the removing efficiency of the fan.

Whenever axial fan revolutions were increased during the removal process, a significant increase also occurred in power consumption.

RECOMMENDATIONS

Based on the results of the present work, it may be assumed that chambers provided with smaller axial fans may give at least, the same performance in ex-
traneous matter removal as present fans do. Therefore, as investigation in this sense is recommended, including also studies on the possibilities of placing the propeller nearer the scattering area of vegetal mass and a reduction in propeller rotation.

The study of the effect of the vegetal mass spreading drum on the removal chamber, taking into account its right location and driving as well as its shape, in order to suppress the effect on cane losses and increase its efficiency in extraneous matter removal is recommended new ways varying of extraneous matter.

REFERENCES


2. Laboratorio Tensometrico. CICMA (1977). Informe de las pruebas energeticas realizadas al extractor axial de la cosechadora L-1200 B.


CAMARA PARA REMOVER LA MATERIA EXTRANEA DE LA CAÑA DE AZUCAR BAJO AUMENTO PROGRESIVO EN ALIMENTACION DE UNA MASA VEGETAL

Urioste A. Peralta Abreu y Lino E. Abreu

RESUMEN

Este trabajo abarca un estudio sobre el funcionamiento de una camara de aspercion con aumento progresivo en alimentacion de una masa vegetal con una cantidad constante de materia extraña; la repeticion de algunas pruebas previas usando un compuesto diferente para establecer una comparacion de los resultados obtenidos; un estudio sobre los efectos en el funcionamiento de la camara como resultado de las variaciones en la devicion de materia extraña expulsada; y finalmente, una revision del funcionamiento de los indicadores al aumentarse las revoluciones del ventilar axial.

Los resultados dictan nuevas normas sobre las dimensions futuras de la camara de aspercion en maquinas cosechadoras asi como relocalizacion del propulsor mas cerca del area de dispersion de materia vegetal y posiblemente reduccion de consumo de potencia del ventilador axial.