HARVESTING THE MILK CROP

I. Introduction

A. Quantity
   1. Effective let down (Premilking procedures)
   2. Effective machine function
      a. Mechanics
      b. Application of mechanics
         i. milking procedures
         ii. parlor design

B. Quality
   1. Health of the cow
      a. Mastitis
      b. Teat trauma
   2. Residues
      a. Disinfectants
      b. Antibiotics
   3. Cleanliness
      a. Bacteria
      b. Sediment
   4. Milk components

II. Effective Let-down
    A. Gorewit study (See Table 1 below) -- Production and milking variables as affected by duration of premilking stimulation
    B. Summary of proper procedures
### TABLE 1. Production and milking variables as affected by duration of premilking stimulation.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Time of premilking stimulation (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Yield, kg/milking</td>
<td>12.8(^a)</td>
</tr>
<tr>
<td>Peak milk flow rate, kg/min</td>
<td>3.2(^a)</td>
</tr>
<tr>
<td>Secondary peak milk flow, kg/min</td>
<td>1.72(^a)</td>
</tr>
<tr>
<td>Average milk flow rate, kg/min</td>
<td>1.88(^a)</td>
</tr>
<tr>
<td>Time to reach last kg</td>
<td>1.87(^a)</td>
</tr>
<tr>
<td>Machine-on time, min</td>
<td>6.8(^a)</td>
</tr>
<tr>
<td>Fat, %</td>
<td>3.14(^a)</td>
</tr>
<tr>
<td>Protein, %</td>
<td>3.18(^a)</td>
</tr>
<tr>
<td>Somatic cells x 10(^3)</td>
<td>81(^a)</td>
</tr>
</tbody>
</table>

\(^{a,b,c,d}\) Means with the same letter in the same row are not significantly different \((P>.05)\) according to Duncan’s multiple range test for variable responses.

Adapted from Gorewit et al., J. Dairy Science, Vol. 68, No. 7.
III. Milking Equipment and Function – Milking machines and mastitis

A. Layout-System Components

Figure 2 -- Milking system layout – Overview 1
Figure 3. -- Components for mechanical milking, claw magnified

Figure 4. -- Milking system layout – Overview 2
Adapted from Bath et al.

Figure 5. -- Milking system layout – Overview  3
B. How components integrate - Function

Figure 6. -- Milk to rest ratio -- pictorial
Note that all measurements are taken at points where the curve intersects lines 1.2 inches of mercury (Hg) above atmosphere and 1.2" Hg below maximum vacuum. The four phases of the cycle are:

a = opening or increasing vacuum phase
b = maximum vacuum phase
c = closing or decreasing vacuum phase
d = atmospheric phase

Figure 1 Pulsation Cycle
Figure 8.-- Milk to rest ratio
REVERSAL OF DIRECTION OF FLOW IN THE SHORT MILK TUBE WITH OPENING OF THE LINER

Figure 9.-- Backjetting
C. Standards

Figure 11a. -- Slope of milking line

Figure 11b. -- Number of milking units recommended
Correction to: NEW GUIDELINES FOR SIZING MILKLINES.

by Reinemann, Billon, Ronningen and Mein.

The following tables, which correspond to the draft ISO standard, are correct.

There were errors in the original tables submitted for the proceedings, NMC 1995.

<table>
<thead>
<tr>
<th>ID</th>
<th>Slope</th>
<th>0.5%</th>
<th>1.0%</th>
<th>1.5%</th>
<th>2.0%</th>
<th>0.5%</th>
<th>1.0%</th>
<th>1.5%</th>
<th>2.0%</th>
</tr>
</thead>
<tbody>
<tr>
<td>48 mm</td>
<td>4</td>
<td>6</td>
<td>8</td>
<td>9</td>
<td>48 mm</td>
<td>2</td>
<td>4</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>60 mm</td>
<td>7</td>
<td>11</td>
<td>15</td>
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<td>60 mm</td>
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<td>9</td>
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<td>16</td>
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<td>(31)</td>
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<td>21</td>
<td>(23)</td>
<td>(28)</td>
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<tr>
<td>98 mm</td>
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<td>(–)</td>
<td>(–)</td>
<td>98 mm</td>
<td>(30)</td>
<td>(60)</td>
<td>(–)</td>
<td>(–)</td>
</tr>
</tbody>
</table>

Table 1. Maximum number of milking units per slope to maintain stratified flow for parlours with units attached every 10 seconds per slope and an average peak milk flowrate of 4 litres per minute per cow.
Table 2. Maximum number of milking units per slope to maintain stratified flow for parlours with units attached every 10 seconds per slope and an average peak milk flowrate of 5 litres per minute per cow.

<table>
<thead>
<tr>
<th>ID (mm)</th>
<th>0.5%</th>
<th>1.0%</th>
<th>1.5%</th>
<th>2.0%</th>
<th>0.5%</th>
<th>1.0%</th>
<th>1.5%</th>
<th>2.0%</th>
</tr>
</thead>
<tbody>
<tr>
<td>48</td>
<td>3</td>
<td>4</td>
<td>6</td>
<td>7</td>
<td>48</td>
<td>2</td>
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<tr>
<td>60</td>
<td>6</td>
<td>9</td>
<td>11</td>
<td>15</td>
<td>60</td>
<td>4</td>
<td>7</td>
<td>10</td>
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<tr>
<td>73</td>
<td>10</td>
<td>19</td>
<td>(20)</td>
<td>(23)</td>
<td>73</td>
<td>9</td>
<td>16</td>
<td>25</td>
</tr>
<tr>
<td>98</td>
<td>(25)</td>
<td>(48)</td>
<td>(–)</td>
<td>(–)</td>
<td>98</td>
<td>(23)</td>
<td>(43)</td>
<td>(–)</td>
</tr>
</tbody>
</table>

NOTE: ID - internal diameter of milkline. The calculations indicate an unlimited number of units for some combinations. These are identified by parentheses, e.g. (23), in the tables. The figures in parentheses show the maximum number of milking units per slope for these design combinations if units were attached at intervals of 5 seconds per slope. Combinations with an unlimited number of units per slope for a 5 second per slope attach rate are indicated by (–).
Table Guidelines for sizing milk lines

1. Slope
2. Size of lines
3. Lift
4. Pump capacity
5. Claw
6. Liner
7. Controlled air admission

D. Efficiency

1. Automation
2. Parlor design
MILKING PARLOR VIDEOS

• Surge

• merlin
  – https://video.search.yahoo.com/search/video?fr=yfp-t&p=youtube+milking+parlor+robotics#id=28&vid=84485f7849c4ee6da8cc5c4db3fc6f7a&action=view

• Gea rapid exit parallel
  – https://www.youtube.com/watch?v=Gu_mOA9WCJo

• Melkvee, NL
  – https://www.youtube.com/watch?v=axEbVnElXMw


ROBOTIC MILKING PARLORS

• Trade off:
  – Decrease in labor needs
  – Increase in cost
  – Increase in culling
    • Cows not wanting to enter
    • Cows’ mammary glands misshapen

• Cow’s Perspective:
  – Another opportunity to eat grain
  – Opposed to another opportunity to be milked 2-3X/DAY
Figure 12. -- Side-opening parlor

Figure 13. -- Herringbone parlor
Fig 5-4. 16-stall trigon parlor.

Figure 14. -- Trigon parlor

Figure 15. -- Rapid exit parallel
Figure 16. -- Rapid exit herringbone
Measuring Parlor Efficiency

• **How often does the parlor turnover per hour, parlor turns/hr:**
  - Example: 100 cows milked in a double 10 herringbone milking parlor in 2 hours by 1 person (milker)
  - (100 cows/2 hours/20 stalls)= 2.5 turns/hour

• **How often does the parlor turnover per hour, parlor turns/hr:**
  - Example: 4500 cows milked in a 72 stall rotary milking parlor in 10 hours by 3 people (milkers)
  - (4500 cows/10 hours/72 stalls)= 6.25 turns/hour
  - This means that in 60 minutes, 3600 seconds, 450 cows are milked or (3600/450)= 8 seconds/cow to load.
  - Or, if we decrease the time to load to 6 seconds, that would be: (3600 seconds-hr/n cows)= 6 seconds, 600 cows per hour.

• **Number of cows per person per hour**
  - Example: 100 cow double 10 with one milker, 2 h
    - 100 cows/1 milker/2 hours= 50 cows per milker/hr
  - Example: 4500 cows milked in a 72 stall rotary milking parlor in 10 hours by 3 people (milkers)
    - 4500 cows/3 milkers/10 hours = 150 cows/person/hr

• **Pounds of milk produced per person per hour**
  - Example: 100 cow double 10 with one milker, 2 h where cows produce 80 pounds per day
  - 100 cows/1 milker/2 hours= 50 cows per milker/hr
  - 50 cows per milker/hr, 40 pounds per milking: 2000 pounds of milk per milker per hour
  - Example: 4500 cows milked in a 72 stall rotary milking parlor in 10 hours by 3 people (milkers)
  - 4500 cows/3 milkers/10 hours = 150 cows/person/hr, 40 pounds per cow per milking= 6000 pounds per milker per hour