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INTRODUCTION

Dairy Farmers of Ontario supplies milk to approximately 66 plants on a regular basis. Most of these plants receive milk every day, but some smaller plants may only order milk as required. Milk is delivered to the plants by some 227 tank trucks ranging in size and type, i.e., 13,000-litre tandem axle tank trucks to 40,000-litre trailers and trains. Most of these trucks pick up and deliver at least two loads of milk each day.

The 66 plants receiving milk can be broken down as follows:

<table>
<thead>
<tr>
<th>Type</th>
<th>Quantity</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluid</td>
<td>20</td>
<td>(Supplied on-demand)</td>
</tr>
<tr>
<td>Industrial (non-quota)</td>
<td>12</td>
<td>(Supplied on-demand)</td>
</tr>
<tr>
<td>Industrial (quota)</td>
<td>34</td>
<td>(Supplied based on Plant Supply Quota)*</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>66</strong></td>
<td></td>
</tr>
</tbody>
</table>

* Several of the industrial quota plants will also submit on-demand milk orders related to fluid cream and ice cream requirements (dual-purpose plants).

As the Ontario dairy industry continues to change, fewer farms are producing more milk per farm and fewer trucks are transporting milk further distances to fewer, but larger plants. Without careful planning, consolidation within Ontario’s dairy industry often results in significant receiving delays as plants attempt to process increasing volumes of milk.

Such delays result in increased transportation costs and an increase in the price of milk to the processor and ultimately the consumer.

The purpose of the following guidelines is to provide companies with additional information to help them when making decisions on plant consolidation and/or upgrading their milk receiving systems to accommodate additional milk throughput.

GUIDELINES FOR OPTIMIZING CIP TANKER WASHES

Introduction

In consultation with the two main chemical suppliers, several recommendations have been made to optimize CIP milk tanker washes. Several factors will improve and optimize tanker CIP washes. The spray ball is the key variable that, along with flow rates, temperature, and chemical concentration, determines whether the tanker will get washed properly. In order to have every plant able to clean tankers properly and efficiently, it may be necessary for the industry to standardize the type of spray ball utilized in all of its milk transport tankers.
The flow of liquid to the tank and the return flow must be balanced properly to achieve an effective wash. Proper transition steps are important to optimize the length of the wash. The two companies consulted recommend similar washes that would take between 18-25 total minutes. This is only achievable by following the recommendations in the body of this report.

Plants should have different washes for different products depending on degree of difficulty to clean, but milk should be the same from plant to plant. By reducing the wash time, the total unloading times could then be reduced, as the wash is normally the limiting factor.

**Spray Balls**

The spray ball is the variable from which the rest of the system follows. In order to ensure proper cleaning, the industry may want to consider standardizing the spray ball that must be used in all milk tankers. One that was recommended is SB-18. It will cover an area of five (5) feet in radius and will deliver 40 USGPM at 25 psi. Another equally effective spray ball is model J6.

It is recommended that a flow rate of between 0.15 – 0.30 USGPM/ft$^2$ be used to effectively clean tankers. This recommendation would indicate that a standard tandem requires a flow rate of 120 USGPM which would equate to three spray balls spaced appropriately. A tanker trailer would require a flow rate of 240 USGPM which would use five spray balls. A variable frequency drive on the supply pump can be utilized to provide the correct flow for each tanker. A flow-meter on the supply line would allow the operator to ensure that the flow is correct. A tandem should have a one and half-inch feed line and a tanker should have a two-inch feed line.

The spray balls must be located to cascade liquid onto the tank surface and not deflect off the tank wall. The recommended spray balls should be mounted 30 inches below the top surface of the tank using a one-inch fitting. Transporters should have a maintenance program to remove, clean and check the spray balls on a monthly basis. Defective spray balls should be replaced.

The spray ball is the starting point to ensure that cleaning liquid is delivered to all corners of the vessel and the milk tanks are cleaned properly.

**Flow Balancing**

Once the flow rate has been established, the return pump must be sized to keep the tank completely evacuated. Balancing the two flow rates minimizes drain times after pre-rinse, at the completion of chemical recirculation and after post-rinse steps as minimal pooling will have occurred in the tanker. A poor balance of CIP supply and return can easily add 5+ minutes to the overall length of the wash.
A poor wash is probable if pooling occurs as a “bathtub” ring will occur at the upper level of the pooled wash solution. A high level of water in the bottom of the tanker does not allow rinse and cleaning solution to sheet down the walls and provide the “scrubbing” action needed to clean the tanker walls. Draining of pooled cleaning solution and rinse water will also create problems, as soils in the water will tend to settle to the floor of the tanker as the pooled water is slowly evacuated from the tanker.

Proper balancing can be achieved a number of ways. Variable frequency drives on the CIP return pump would allow the speeds of the supply pump and return pump to be matched. A high quality air eliminator on the suction side of the CIP return pump will also prevent air from being trapped at the face of the CIP return pump and will eliminate pump cavitation.

A liquid ring pump on the CIP return will eliminate pump cavitation and therefore the potential for pooling. A large liquid ring pump allows the return pump to be higher in pumping capacity than the CIP supply pump, therefore draining times are almost eliminated and wash times will be shorter. If this pump is sized to match the requirements of the largest tanker, it will also function properly for smaller tankers.

**Efficient Transition Steps**

Time can easily be wasted through inefficient transition steps from pre-rinses to chemical recirculation and also from chemical recirculation to post-rinses. Rinse water and chemical solution must be efficiently evacuated from the tanker and lines when moving from one step to the next. Some CIP systems will have timed transition steps to push rinse water or chemical solution from the tanker as the program steps forward. If these times are too long, time and chemical solution are wasted. If too much rinse water is used to push the chemical solution from the system after the chemical recirculation step, the CIP chemical tank will be unnecessarily diluted and cooled. This will waste time during the next wash as additional time will be required to bring the chemical solution up to the target temperature and chemical strength (if conductivity is used with traditional chlorinated alkalis).

Efficient transition steps can be accomplished by monitoring either the return water/solution temperature or conductivity. If these parameters are monitored on the return lines at the CIP system, the PLC controlling the system can efficiently decide when to start returning solution to the CIP tank or when to send rinse water to the drain. This will not only reduce the length of these steps but it will also maximize the amount of chemical solution reclaimed and will minimize the drop in temperature of the CIP chemical tank.
Insulated CIP Chemical Tanks/Chemical and Temperature Loop

If long times exist between wash cycles, an insulated tank will maintain the temperature of the tank, therefore minimizing the amount of time required to bring the solution up to temperature in the first wash after the delay. If traditional chlorinated alkalis are used, the CIP tank can be designed with a separate loop of piping to monitor chemical strength and temperature on a continuous basis. When the tank is not in use it can continuously be re-circulated by a conductivity probe and through a heat exchanger. By doing this, the tank will always be maintained at the target temperature and chemical strength therefore minimizing the time wasted waiting for these parameters to be reached during subsequent washes.

The heat exchanger must be large enough to keep up with the demand for heated water and chemical solution without being a bottleneck in the system. If a demand system is used, it should be designed to elevate the highest flow required to the desired temperature in one pass. The heat exchanger used on a re-circulation system would depend on the activity of the plant. However, the liquids should be at temperature when a wash is required.

Optimal Length of Tanker Wash

If these guidelines are utilized, pre and post-rinse times, chemical solution preparation times, and transition times can be minimized. The wash sequences recommended by both consulted suppliers are similar. The following is a summary of the wash sequence.

<table>
<thead>
<tr>
<th>Step</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-rinses</td>
<td>3 x 30 seconds</td>
</tr>
<tr>
<td>Pre-rinse drain steps</td>
<td>3 x 30 seconds</td>
</tr>
<tr>
<td>Rinse to chemical transition</td>
<td>30 seconds</td>
</tr>
<tr>
<td>Chemical recirculation</td>
<td>480 seconds (DL) – 900 seconds (EL)</td>
</tr>
<tr>
<td>Chemical drain down &amp; recovery</td>
<td>30 seconds</td>
</tr>
<tr>
<td>Chemical to rinse transition</td>
<td>30 seconds</td>
</tr>
<tr>
<td>Post-rinses</td>
<td>3 x 30 seconds</td>
</tr>
<tr>
<td>Post-rinse drain steps</td>
<td>3 x 30 seconds</td>
</tr>
<tr>
<td>Sanitize</td>
<td>120 seconds</td>
</tr>
<tr>
<td><strong>Total Time</strong></td>
<td><strong>17.5 minutes (DL) – 24.5 minutes (EL)</strong></td>
</tr>
</tbody>
</table>

Note: One of the consulted suppliers maintains that this program is in place in many of their plants with good results. The other believes that the longer wash is required.

The size of the tanker is irrelevant to the length of wash as long as the flow rates and spray ball specifications noted earlier are followed. A different wash and length of wash may be needed when cleaning a tank that had something like a cream-based or high solids product in it.

The acid wash cycle should be very similar in length to the alkali wash. This would discourage drivers from doing an acid instead of alkali wash to save time.
Acid Wash

The Ontario *Milk Act* and Regulations state that tank trucks should not receive more than one acid wash cycle per week. It is recommended that Wednesday be designated as the day that all plants will provide their acid wash to transporters. Plants using an enzymatic wash in their CIP system should perform acid washes on the first Wednesday of every month. Each truck should receive a maximum of one acid wash each Wednesday.

Summary

It is possible to provide satisfactory tank cleaning in as little as 18 minutes if all of the following points are completed.

1. Establish the correct spray ball and position the appropriate number in each tanker, spaced accordingly.
2. Provide a variable speed supply pump capable of delivering the required flow for the largest tank received.
3. Provide a variable speed return pump capable of keeping the tank completely evacuated.
4. Reduce time required for the transition steps using conductivity, temperature or better timing to reduce water being added to the return tank.
5. Insulate tanks and provide enough heating capacity that the system does not have to wait for the liquids to come up to temperature.
6. Experiment with wash cycles to provide satisfactory cleaning in the shortest time.
7. Programs and or recording devices that monitor and record time, temperature and conductivity during the wash are available to provide the plant and transporter with a good record of the wash.
MILK RECEIVING BAY GUIDELINES

Ontario Regulation 761 outlines plant milk receiving requirements under the Milk Act. In addition to the requirements outlined in this regulation, DFO is greatly interested in providing all potentially new processors and processors contemplating modifying their milk receiving facilities with as much input as possible, to minimize future problems.

The following is a summary of DFO’s requirements which will help to ensure that your facility will accept current milk truck configurations:

**Receiving Bay Dimensions (Minimums)**

<table>
<thead>
<tr>
<th>Door:</th>
<th>Height</th>
<th>14 ft.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Width</td>
<td>12.5 ft.</td>
<td></td>
</tr>
</tbody>
</table>

Inside dimensions:
- Height, 20 ft. (including room for fall restraint devices)
- Width, 16.5 ft.
- Length, 70 ft. (to accommodate large tractor trailers up to 48 ft.)
- Trains are up to 67 ft. long.

Floor slope should be at least 2 per cent (1 ft. every 50 ft.) for proper drainage.

**Receiving Bay Facilities**

There should be washroom facilities for the drivers readily accessible to the receiving bay without going outside or through the production areas.

There should be a bell, buzzer or telephone in the receiving bay for contacting plant personnel.

There should be a fall restraint device installed in the receiving bay for climbing onto trucks.

There should be a ladder or a platform for climbing onto trucks.

There should be adequate lighting in the receiving bay to properly illuminate all areas.

There should be adequate heating in the bay to prevent the freezing of any water and to bring the temperature up to at least a moderately comfortable level i.e. 60 degrees Fahrenheit in a reasonable time after closing the bay doors.

There should be proper drainage in the bay to prevent the pooling of water, possibly with a sand trap prior to the drain to prevent dirt and debris from truck rinsing clogging the drain.

There should be a sink with adequate hot water and readily available brushes and detergent for washing truck pump components etc.
There should be a desk with a waterproof cabinet for the DFO printer installed where drivers can download the handheld units to the printer and do their paper work.

If a new plant wishes to install a plant meter/sampling system, to measure the volume of incoming milk, then the following requirements will apply. If you do not meet these requirements then your company will purchase their milk supply based on DFO’s volume and milk component information.

**Raw Milk Receiving/Metering System**

The raw milk receiving system should be located in the receiving bay not in the production area.

**The following recommendations are for a new metering system:**

A minimum pumping speed of 800 litres per minute.

A three-inch magnetic meter operated with the E-type vacuum elimination system with a 550 mm air eliminator rated up to at least 1,000 litres per minute.

A high efficiency low rpm pump motor combination such as a 1,760 rpm Fristam/Baldor pump/motor would be economical electrically and treat the raw milk well to keep quality levels high. Also, if you are upgrading to a magnetic metering system there is much less chance of air introduction or vibration problems affecting your meter’s measuring ability.

A piston sampler with a 2 to 2.5 ml piston controlled by the meter.

A crush resistant three-inch tygon receiving hose, no more than 20 feet long.

A depression or a pit with proper drainage for the air eliminator to exceed the minimum four-inch drop from the bottom of the truck outlets to the inlet of the air eliminator to ensure adequate drainage of the trucks and to ensure adequate milk flow to the metering/receiving system to prevent cycling (stopping and starting) of the receiving system.

**CIP SYSTEM**

The CIP system should be adequate to properly clean and sanitize all interior surfaces of any tank truck that may be received by the plant.

There should be enough hot water available to ensure that the CIP system is not starved for hot water resulting in the stopping and starting of the CIP system in between cycles.

The CIP system should be computer-controlled to ensure that the full program of cleaning cycles is followed for the proper lengths of time and that no short cuts can be taken except in the case of emergency shutdown.
Other Contacts

The following are other people in the dairy industry that may want or need to provide input on your plans for construction.

Karen Atchison - Dairy Food Safety, Food Inspection Branch
Ontario Ministry of Agriculture, Food and Rural Affairs, Guelph
Tel. (519) 826-4378.

Tom Kane – President
The Ontario Dairy Council, Mississauga
Tel. (905) 542-3620

John Johnston - General Manager
The Ontario Milk Transport Association, Guelph
Tel. (519) 766-1133.

GUIDELINES FOR DAIRY RECEIVING FACILITIES

In order to ensure timely and efficient unloading and washing of milk trucks at processing facilities, the following minimum guidelines are required.

Silo Capacity

Since most plants don’t process at a consistent level seven days per week, provision must be made to receive milk on a consistent basis by utilizing silos for milk storage. Processors should maintain silo capacity equivalent to at least two average days’ receipts.

Pumping Speeds

Pumping speeds in this context does not refer to the number of pumps, but rather the combined rate at which milk can be unloaded at one processing facility. In establishing these pumping speeds it was recognized that there is a close correlation between pumping speed and wash times. In addition, rather than attempt to identify the minimum number of bays required, the following identifies the minimum number of different truck “spaces” within a plant’s receiving area (some bays can accommodate two trucks, one pumping and one washing).

<table>
<thead>
<tr>
<th>Average Volume Per Day (litres)</th>
<th>Unload/Wash Locations</th>
<th>Pump Speed (litres/hour)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;100,000</td>
<td>1</td>
<td>30,000</td>
</tr>
<tr>
<td>100,000–250,000</td>
<td>2</td>
<td>60,000</td>
</tr>
<tr>
<td>250,000–500,000</td>
<td>3</td>
<td>120,000</td>
</tr>
<tr>
<td>&gt;500,000</td>
<td>4</td>
<td>140,000</td>
</tr>
</tbody>
</table>
Wash Time

The guideline for washing any size of truck is 30 minutes in total. In the previous section “Guidelines for Optimizing Tanker Washes” the guideline indicates that a wash should not take longer than 30 minutes.

Receiving Hours

If a processing facility complies with the other guidelines pertaining to silo capacity, pumping speed, unloading bays and wash times then the following minimum receiving hours should eliminate most waiting time.

<table>
<thead>
<tr>
<th>Average Volume Per Day Hours</th>
<th>Minimum Receiving</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;250,000</td>
<td>8/day</td>
</tr>
<tr>
<td>250,000-750,000</td>
<td>12/day</td>
</tr>
<tr>
<td>&gt;750,000</td>
<td>16/day</td>
</tr>
</tbody>
</table>

Time at the Plant

If all of the above minimum standards are adhered to, it should result in a straight truck being at a plant no longer than 1.5 hours per load and a tractor trailer or a combination unit being at a plant no longer than 2.0 hours.

MILK ORDER AND ALLOCATION PROCEDURES

Order and Allocation Procedures

- Each Monday morning, plants fax in their initial milk order to DFO for the following Wednesday to Tuesday supply period. DFO requests that plants submit their orders prior to 10:00 a.m. Copies of the milk order forms may be obtained by contacting your Marketing Officer or accessed online.

  Note: Plants may revise their initial milk orders prior to 10:00 a.m. on Wednesday, for Friday and Saturday deliveries and 10:00 a.m. on Thursday, for Sunday, Monday, and Tuesday deliveries.

- Staff input the plant orders into the computerized Milk Allocation System (MAS).

- The MAS matches the available loads with the plant’s on-demand milk requirements. Once all of the on-demand requirements are met, (approximately 62 per cent of the total available milk supply), the MAS calculates how much milk remains to be allocated to the 34 quota plants.

- The MAS takes into consideration the plant’s quota, whether it is over-supplied or under-supplied and allocates the quota plant its share of the milk that is available for that day, after supplying the on-demand milk requirements.

- The MAS attempts to schedule the loads into the plants, taking into consideration the time to unload and wash the tank truck and the plant’s receiving window.
The following is a summary of the steps taken to arrive at an allocation solution:

1. Update the load feed, i.e. feed in current load numbers and sizes.
2. Enter plant milk orders.
3. Enter plant opening and closing times (the receiving window).
4. Run the allocation solution.
5. Edit the solution.
6. Fax the delivery schedules to transporters and plants.

The running of a new load feed and the entering of plant orders takes approximately one hour for each day’s schedule.

The running of a solution varies depending on the plant requirements and the load configurations. On average, it takes 1 to 2 hours.

The manual editing of a solution can take 2 to 3 hours.

The faxing out of the delivery schedules to transporters and plants takes about 1 hour.

**Note:** In total, it takes about 4 to 6 hours per daily schedule to arrive at a solution that can be sent out to the plants and transporters. The faxing out of the solution(s) is automatic and is generally done during the late afternoon to early evening period (i.e., 2:00 p.m. to 7:00 p.m.). Plants may also obtain a copy of their milk schedule online.

Unless there are extenuating circumstances, milk delivery schedules are provided to the plants and transporters at a minimum of 48 hours in advance of the delivery date. Changes to a plant’s order after the schedules have been issued requires manual intervention to re-allocate the loads of milk.

Changes to milk orders on short notice are discouraged. Nevertheless, oftentimes DFO has little choice but to divert the necessary loads out of a plant, due to equipment breakdowns. When DFO is required to make such changes, it involves the manual re-allocation of numerous loads, and the plant(s) that are impacted by the changes may be required to add extra shift(s) to process the added volume.
**DFO MILK ORDER**

<table>
<thead>
<tr>
<th>DATE</th>
<th>WEEKLY ORDER DEADLINE MONDAY @ 10:00 AM</th>
<th>FRIDAY &amp; SATURDAY CHANGES DEADLINE WEDNESDAY @ 10:00 AM</th>
<th>SUNDAY, MONDAY &amp; TUESDAY CHANGES DEADLINE THURSDAY @ 10:00 AM</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>WED</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>THU</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>FRI</td>
<td></td>
<td>FRI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SAT</td>
<td></td>
<td>SAT</td>
<td></td>
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<tr>
<td>SUN</td>
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<td>SUN</td>
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<td></td>
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<tr>
<td>MON</td>
<td></td>
<td>MON</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TUE</td>
<td></td>
<td>TUE</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Orders should be total milk litres required for each day.  

Fax to DFO before deadlines. Orders received after deadlines may not be accommodated.
<table>
<thead>
<tr>
<th>DATE</th>
<th>WEEKLY ORDER DEADLINE</th>
<th>FRIDAY &amp; SATURDAY CHANGES DEADLINE</th>
<th>SUNDAY, MONDAY &amp; TUESDAY CHANGES DEADLINE</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MONDAY@ 10:00 AM</td>
<td>WEDNESDAY @ 10:00 AM</td>
<td>THURSDAY @ 10:00</td>
<td></td>
</tr>
<tr>
<td>WED</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>THU</td>
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<tr>
<td>FRI</td>
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<td>FRI</td>
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<td>SAT</td>
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<td>SAT</td>
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<td>SUN</td>
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<tr>
<td>MON</td>
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<td>MON</td>
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<tr>
<td>TUE</td>
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<td>TUE</td>
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</tbody>
</table>

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