Milking Parlor Performance

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Introduction

The size and type of milking parlors on western U.S. dairy farms has changed during the last 10 years. In 1999, performance information was presented on 14 rotary parlors, parallel parlors up to 100 stalls, and herringbone parlors up to 80 stalls at the Western Dairy Management Conference by Smith, et al. This paper on parlor performance will be an update with 61 rotaries and parallels up to 120 stalls. The parlors were evaluated by multiple observations using the time and motion method for determining steady state throughput during the complete milking period. The time required for cleaning the milking system, time between group changes (if the parlor stops or there are no cows in the parlor) and milking the hospital and fresh cow groups are not included. In this way, parlors evaluated in 2000 can be compared with other parlors evaluated since 1960.

Herringbone and Parallel Parlors

Herringbone parlors in the last five years have not increased in size, but parallel parlors have. The 1999 paper at the WDMC (Smith, et al, 1999) reported on herringbones up to 80 stalls and parallels up to 100. Since 1999 there have been a number of parallel parlors with 100-120 stalls built in the western United States. Based upon a limited number of parlors, the one management technique which greatly influences performance of these large parlors is the pre-milking hygiene routine. In the 1999 study Smith reported the use of a pre-dip or full routine of pre-dip or spray, strip, wipe and attach reduced parlor performance by 15-20%. This was not a recommendation of either a minimal or a full routine. The type of dairy housing (free-stall or open corral) management systems, level of mastitis, somatic cell count, and bacteria counts will indicate which pre-milking hygiene routine that needs to be used, not the type of parlor. Table 1 is an update on data through the year 2000 on large herringbone and parallel parlors.

Cows per hour and cows per labor hour is slightly more for the parallel when compared to herringbone parlor up to D-40-44 size. Entry time per cow is slightly less for the 1st cow into the parlor to milking position for parallel parlors, even when the cow has to turn 90?. Walking distance of the operator is less in the parallel parlor. This is especially true of the operator who is doing a preparation routine which requires more than one pass by each animal. Cows per hour is less for both parallel and herringbone when a full pre-milking hygiene is used when compared to the minimal routine (Table 1).

In the large parallel parlor cows per labor hour is highest at D-35 to 40 stalls. Although the data in Table 1 on parallels larger than D-50 is a limited number of observations, the trend is for more cows per hour but the same cows per labor hour.

Rotary Parlors

In the last five years there has been a renewed interest in rotary parlors. The rotary parlor of the late 1990?s has been referred to as the new version. Observation of several changes in design would indicate that the new parlors are largely with the operator on the outside of the platform (external) and the platform contains more stalls which should make them more compatible for easier cow entry and the milk production level of today?s cows which requires a larger platform. Data on rotary parlors reported in 1977 (Bickert and Armstrong) were from 8 to 26 stall parlors. The difference between the set actual entry time per stall as set by the manger-owner and the actual entry time per stall minus the empty stalls and second rotation cows indicated actual performance of parlors was only 61-67% of the manager-owner set entry time per stall. The data reported in this paper is for an average size of 53 stalls (28-120) and now this efficiency averages 80%. The second major design change is that the majority of the rotary platforms installed in the U.S. from 1995 to 2001 are concrete platforms. An interesting observation in platforms in Australia are that where once the majority were steel platforms, the majority today are concrete platforms. Of the 20 parlors presented in this paper, observed in October 1999 and 2000, 19 are concrete and one is steel. Another observation of the present rotary platform design is the addition of more support wheels and improvement in the undercarriage of the platform.

During the past three years the authors of this article have traveled in the U.S., Mexico and Australia to collect data on rotary parlors. Presently, there are 61 parlors in the database. Thirty-seven of these parlors are in the U.S., 4 in

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Mexico, and 20 in Australia. Data was collected for complete milkings and in the majority of parlors for repeat milkings and repeat observation at different times of the year. Data collected included: (1) owner-operated set entry time/stall (seconds per stall), (2) actual entry time (seconds per stall), (3) time required to make one complete rotation of the parlor, (4) number of empty stalls per rotation, (5) number of cows which go around a second time (either voluntarily or unvoluntarily) per rotation, (6) stops per rotation for problems at entry, exit, miscellaneous (machine repair, problem cows, routine catch-up time, etc.). Other observations recorded were; (1) direction of rotation, (2) slope of platform (toward the inside or toward the outside), (3) milk production level of herd, (4) milking frequency, (5) platform surface, (6) platform and equipment manufacturers, (7) attachment time of milking units (on some parlors), (8) pre-milking hygiene routine, and (9) number of operators (including personnel in holding pen assisting cows onto the platform). Personnel making group change are not included in milking personnel). Measurements of entry lane included width and length and angle of front of holding pen was recorded.

Data from the parlor was then used to calculate; (1) the owner-operator cows per hour maximum possible parlor performance, (2) actual cows per hour performance, (3) number of actual rotations per hour, (4) cows per labor hour. A parlor performance efficiency rating based upon the theoretical rotation time of the platform divided by actual rotation time of the platform minus the number of stalls which were empty or used by cows making a 2nd rotation.

The database was then evaluated by; (1) country, (2) internal vs. external parlors, (3) pre-milking hygiene routine, and (4) three different groups of parlor size for U.S. parlors. Different widths and lengths of entry lanes where evaluated for their effect on cow entry. Number of stalls for cow exit at different rotation speeds was evaluated. Stall angle on the platform was observed for its effect on cow entry and exit as well as the angle of the front of the holding pen on cow entry. Width of exit lane and placement of foot bath or sort gates was also observed. Finally the influence of the slope of the cow platform (in or out) on leg position was noted. Summary of the data for all parlors is presented in Table 2.

Mexico Parlors

The four parlors in Mexico consisted of one internal rotary with a steel platform and three steel, external platforms. Summary of the data is also in Table 2. Although the number of parlors is small, there are several small differences, which resulted in the efficiency of these Mexican parlors being less than the U.S. or Australian parlors. The set (owner-manager) entrance time was low (8.4 seconds per stall) resulting in more frequent and longer stops for cow exit for the external parlors. The internal parlor also had more frequent stops for cow entry. One external and one internal parlor had efficiency rating of 61% which lowers the average for the four parlors. The steel external platform also had more frequent, longer stops to exit cows with leg problems. This also has been observed in U.S. parlors.

Australian Parlors

The database for the 20 Australian parlors is also presented in Table 2. This data was collected during the last two weeks of October, 1999 and 2000. With seasonal calving being practiced on these dairy farms, the data collection period was during highest milk production with herds averaging 80-110 days in milk. Some late calving heifers were still adjusting to the parlor, which made the parlor atmosphere similar to U.S. parlors.

The Australian dairy industry has had more experience with rotary parlors, as they have a higher percent in use over a longer period of time. Rotary parlors in this data base have been in use from 1 to 12 years. Traditionally, the parlor is in operation for 1-1/2 to 2-1/2 hours a milking. Even with a 1,400 cow dairy the milking time was less than 3 hours. In the majority of parlors, the owner or manager is involved with at least one milking and usually all milkings each day.

The Australian parlors also have a higher efficiency rate by 5% (84% Australia vs. 79% U.S. parlors) which is a measurement of rotation time per stall set by the owner-manager, minus the time the parlor is stopped, plus, 2nd cow rotation and empty stalls. Why? An observation would be the operators with more experience and training on rotary parlor platforms. Although the number of cows going around the second time was high (the period of data collection was at peak milk time), both empty stalls and stops per rotation were less than U.S. parlors. The entry on the platform was quicker for Australian parlors, which had a long entry lane (13-15 ft) that was about 33 inches wide, and with the angle of the fence closest to the parlor at 30-45 degrees than those with a flat 15-20 degree angle and shorter entry lane of 7-8 feet, presently being used in the majority of U.S. rotary installations. Cows per labor hour was 147 compared to 99 for U.S. parlors because of the use of a minimal or no pre-milking hygiene routine in the majority of Australian parlors. All parlors were feeding grain on the platform. Operators said entry on the

platform becomes much more aggressive in late lactation or when the availability of feed in the pasture becomes less. In summary, we can learn considerably from the Australian dairy industry on design and management of rotary parlors especially if observations are made when milking conditions are similar to the U.S.

Internal vs. External Rotaries

The data from Table 3 representing the internal operator vs. the external operator shows that the external operated parlor efficiency (81%) is more than the internal parlors (70%). Cows per labor hour are also higher for the external operated parlors. Although missed stalls and cows going around the second time per rotation are less for the internal parlor, total stops per rotation are greater. Rotations per hour for external operated parlors are less than internal operated. Although this data base only represented 5 internal operated parlors, it would indicate that they are less efficient, which may be a factor in why there are less internal operated parlors being built.

Full vs. Minimal Pre-milking Hygiene Routine

Pre-milking hygiene routine, presented in Table 4, was divided into three sub-groups: none, minimal, and full. As would be expected, cows per labor hour is greater for minimal pre-milking hygiene routine when compared to a full routine because the minimal routine requires fewer operators. The 13 minimal routines broke into three categories; 3 strip only, 3 wipe only and 7 wipe and strip. In several parlors where wipe and strip was being used, the speed of the platform was not allowing sufficient time for both of these routines to be done 100% of the time. It would appear that the owner-operator set rotation time per stall must be 12 seconds or greater for both wipe and strip to be completed. On dairy farms which practiced a full pre-milking hygiene routine the average milk production per cow was 73 lbs., compared to 64 lbs. for herds where a minimal routine or no routine was practiced. The difference of 9 lbs. may be partially explained by the improved pre-milking stimulation, which usually occurs with a full milking hygiene, which improves let-down response. In the minimal pre-milking routine herds it is not uncommon to see a partial let-down after the milking unit is attached and then milk flow stops for one to one and half minutes (7-10 stalls) before a second let-down occurs.

Three Sub-groups by Size

An analysis of three sub-groups of the external operated rotary platforms is presented in Table 5. From this data, differences in performance of different parlor sizes can be analyzed. As rotary parlor size increases the owner-operator set entry time per cow is faster. The difference is largely due to large rotary platforms are built for larger herds in use more hours per day, therefore the pressure to milk more cows results in a stall rotation time which is faster. Cows per hour is higher in the larger parlors with more operators being used (a larger percent of the small and large parlors used a full pre-milking hygiene routine) resulting in a lower cows per labor hour. Missed stalls per rotation was lowest in the 48-54 size rotaries. Cows going around the 2nd time was lowest in the smaller (24-44) and medium-sized parlors (48-54). Total stops per rotation was highest in the smaller rotary parlors. Rotation of platform per hour was very close to the same for all parlors sub-groups.

If a dairy owner is considering building a rotary parlor, the number of cows and hours a day it will be used will determine stall entry time to milk the number of cows they desire, but the platform must be large enough to milk the herd now and with future higher milk production. An owner should select a parlor size that allows about an 11 to 12 second entry time with about 9 minutes of unit on-time at 80% efficiency.

Maintenance and life expectancy of the tables was discussed with owner-managers to try and evaluate the life expectancy of the tables. Because a large number of the parlors being sold in the U.S. which are manufactured in Australia, this may give our dairy industry an insight as to what to expect in the future. Table 6 is a summary and projection of maintenance or replacement of major components of rotary platforms from personal communication with dairy farm owners and managers. One message, which was repeated by owner-managers in Australia, was that maintenance and replacement would be influenced by the number of hours of operation. Preventive maintenance and future improvement in components will also influence replacement of components.

Summary

A considerable amount of this performance data is available with existing computer programs without personnel being present. However, the authors of this article chose to personally take the data to help answer questions concerning future decisions in parlor design and management, including the reason for the stops, entry and exit design effect on stops, empty stalls, 2nd cow rotation, parlor size as it affects the operator routine for reattach or adjustment of units, pre-milking hygiene?s effect on operator?s ability to complete his or her duties, etc.

Table 7 is a summary of the performance of the 61 rotary parlors. Table 8 includes the summary of recommendations in rotary parlor design.

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Table 1. Milking parlor performance on dairy farms using herringbone and parallel parlors with different pre-milking hygiene routines for 3X milking.

	Herringbone[c]				Parallel			
	Full[a]		Minimal[b]		Full[a]		Minimal[b]	
Parlor size	Cows /hour	Cows/ labor hr	Cows /hour	Cows/ labor hr	Cows /hour	Cows/ labor hr	Cows /hour	Cows/ labor hr
D-20-24	210	70	185	93	217	72	202	101
D-25-29	230	77	252	84	231	58	227	91
D-30-34	—	—	—	—	270	90	280	93
D-35-39	—	—	390	98	280	112	390	130
D-40-44	392	56	408	102	385	96	491	123
D-45-49	—	—	—	—	396	79	528	106
D-50-54	—	—	—	—	460	92	540	108
D-55-59	—	—	—	—	517	103	—	—
D-60	—	—	—	—	497	99	532	107

[a]pre-dip, strip, wipe, attach
[b]strip and attach or wipe and attach
[c]herringbones are parlors with stalls from 34 to 45 inches on center

Table 2. Rotary milking parlor performance on dairy farms.

	No. of parlors	No. of stalls	Set ent. time	Actual ent. time	Actual cows /hr	%[a] eff.	No. of oper.	Cows/ labor hr.	Milk prod.	Missed stalls p/r	2x cows p/r	Total stops p/r	Cow/ stall hr.	Rota./ hr.
All parlors	61	53	10.8	12.9	298	80	3	114	67	1.5	3.0	4.0	5.6	6.0
U.S. only	37	50	12.0	14.0	281	79	3	99	69	2.0	2.0	5.0	5.5	6.0
Mexico only	4	57	8.4	11.6	321	73	3.6	97	62	1.7	2.3	5.3	5.6	5.7
Australia only	20	58	10.0	11.0	325	84	2	147	63	1.0	5.0	2.0	5.7	6.2

[a]Percent efficiency (is a measurement of rotation time per stall set by the owner-manager divided by the actual rotation time per stall minus the time the parlor is stopped, 2nd cow rotations, and empty stalls.

Table 3. Internal vs. External operator effect on rotary milking parlor performance on dairy farms.

	No. of parlors	No. of stalls	Set ent. time	Actual ent. time	Actual cows /hr	%[a] eff.	No. of oper.	Cows/ labor hr.	Milk prod.	Missed stalls p/r	2x cows p/r	Total stops p/r	Cow/ stall hr.	Rota./ hr.
Internal	5	38	14.0	19.8	193	70	2.5	89	65	.6	.1	5.9	5.2	5.2
External	56	55	10.5	12.3	308	81	2.9	117	67	1.6	3.2	3.8	5.6	6.1

[a]Percent efficiency (is a measurement of rotation time per stall set by the owner-manager divided by the actual rotation time per stall minus the time the parlor is stopped, 2nd cow rotations, and empty stalls.

Table 4. Pre-milking hygiene routine effect on rotary milking parlor performance on dairy farms.

	No. of parlors	No. of stalls	Set ent. time	Actual ent. time	Actual cows /hr	%[d] eff.	No. of oper.	Cows/ labor hr.	Milk prod.	Missed stalls p/r	2x cows p/r	Total stops p/r	Cow/ stall hr.	Rota./ hr.
None[a]	24	57	9.6	11.0	328	82	2.4	114	63	1.2	5.0	2.7	5.8	6.3
Minimal[b]	13	51	10.9	12.4	295	82	2.7	114	66	2.3	2.1	4.2	5.8	6.2
Full[c] Routine	19	53	11.4	13.8	291	79	3.7	85	73	1.8	1.7	4.8	5.3	5.7

[a]none—no pre-milking hygiene
[b]minimal routine—strip and/or white and attach
[c]full routine—pre-dip, strip, white, attach
[d]Percent efficiency (is a measurement of rotation time per stall set by the owner-manager divided by the actual rotation time per stall minus the time the parlor is stopped, 2nd cow rotations, and empty stalls.

Table 5. Sub-groups by size (stall number) rotary milking parlor performance on dairy farms.

	No. of parlors	No. of stalls	Set ent. time	Actual ent. time	Actual cows /hr	%[a] eff.	No. of oper.	Cows/ labor hr.	Milk prod.	Missed stalls p/r	2x cows p/r	Total stops p/r	Cow/ stall hr.	Rota./ hr.
22–24 stalls	14	39	14.1	16.7	211	78	2.4	105	64	2.1	2.2	4.5	5.4	6.1
48–54 stalls	25	50	10.8	12.5	284	83	2.3	130	66	1.2	2.0	3.4	5.7	5.9
60–116 stalls	17	74	7.2	8.22	422	81	4.3	108	71	2.0	5.8	3.8	5.7	6.3

[a]Percent efficiency (is a measurement of rotation time per stall set by the owner-manager divided by the actual rotation time per stall minus the time the parlor is stopped, 2nd cow rotations, and empty stalls.

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Table 6. Estimated projection of maintenance or replacement of major components on rotary platforms manufactured in Australia and operated in Australia and United States.

	Australia 4 hrs. daily use	United States 20 hrs. daily use
Drive unit		
minor maintenance	1–2 yearly	5–10 yearly
major replacement	10 years	2 years
Wheel bearing replacement	8 years	1.5 years
no difference between steel/nylon	—	—
Central Swivel (gland)	depends on manufacturer 6 months–5 years	?
Table surface		
Concrete	15 years	?
Steel	depends on manufacturer 5–10 years	?

Table 7. Summary of performance of 61 rotary parlors in Mexico, Australia and United States.

1. Entrance time tends to decrease as parlor gets larger.
2. Rotation time of the platform averages 6.0 per hours (3.8–8.0) and is not influenced by parlor size.
3. Pre-milking hygiene effects cows per labor hour.
   a. All parlors 114 per hour (range 47–206)
   b. Minimal or none 119 (range 64–200)
   c. Full routine 85 (range 47–206)
4. 1.5% of stalls are empty per rotation (range 0–12%)
5. 3.0% of cows go around second time per rotation (range 0–24.5%)
6. Average number of stops per rotation for entry, exit, machine repair, etc. 4.0 (range 0–11)
7. Average parlor efficiency as measured by owner/manager set cow entry time divided by actual cow entry time minus empty stalls and 2nd cow rotation was 80% (range 47–97%)
8. Cows per hour average 298 (range 103–597)
9. Cows per labor hour highest in the parlor size of 48–54 stall groups.
10. Cows per hour highest in the 60–116 stall group.

Table 8. Summary of design observations in 61 rotary parlors in Mexico, Australia and United States

1. Majority of platforms are concrete (51 concrete vs. 10 steel) and slope inward.
2. Milking machine attachment is fastest in large parlors with fast entry time, parlor rotation direction clockwise vs. counterclockwise have little effect.
3. Entry design for best cow entry
   a. 33" wide chute
   b. 14–16' long chute
   c. Shield operator and exit area in entry chute
   d. Angle of front of holding pen 45 degrees and shield area from attachment area.
   e. Holding pen width 36–38' or less
4. Exit area design for best cow exit
   a. 3 stall width for rotation time of 11 seconds per stall or greater
   b. Exit lane 6–10' wide
   c. All cow sort gates and foot baths minimum of 60' from parlor unless sort gate is manually operated
   d. Shield cow exit from cow entry near platform