MILK and FOOD SANITATION

A STUDY OF MILKING MACHINE INFLATIONS MADE OF NEOPRENE COMPARED WITH THOSE OF NATURAL RUBBER*

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Several types of neoprene inflations for milking machines were compared under actual farm conditions with those of natural rubber. Physical changes in volume and weight were measured and bacteriological comparisons were made by both the swab technique and the dynamic methods. Neoprene inflations consistently outlasted rubber, and neoprene showed less distortion in shape. The bacterial population of neoprene was consistently less than that of rubber.

A study was made on the milking efficiency of neoprene inflations and rubbber inflations of similar shape. In these tests neoprene was slightly superior to rubber in speed of milking and amount of milk produced.

The synthesis of natural rubber as produced by the tree has never been accomplished in the laboratory. The so-called synthetic rubbers are elastic materials, termed elastomers, resembling the natural product in physical properties but differing from it in chemical composition. One of these elastomers is known as neoprene.

Neoprene (polymerized. 2 — Chloro—1, 3. outadiene) resists the destructive action of grease, heat, and chemicals. At present it is being used in the manufacture of many articles among which are milking machine inflations.

Since this material is fat resistant, neoprene inflations should have a longer life; and because of the greater resistance to cracking and checking would be expected to harbor fewer bacteria. Chemical and heat resistant qualities should also improve its performance.

This study was designed to compare the performance of neoprene and natural rubber inflations under similar circumstances and actual farm conditions.

Much has been written about the effect of inflation condition on the bacterial population and on the performance of milking equipment.

Claydon[1] made a microscopic and bacteriological study of used inflations in comparison with new ones to determine the effect of surface deterioration that could not be seen. He found that inflations in the early stages of surface deterioration are more susceptible to bacterial contamination than are new liners, even though they often appear to be almost similar in general physical condition. Cone[2] found that the rubber inflations and tubes of milking machines are the greatest source of thermoduric bacteria. Claydon[1] developed a test whereby sterile water was pulsated in the inflation and the bacterial population of the water determined. This physical manipulation should present a truer picture of the contamination in the inflation.

Moir[3] found discarded inflations to contain an average of 10 per cent by weight of fat. The fat was not evenly distributed, and certain parts frequently contained as high as 30 per cent. Prolonged treatment of the rubber in strong, hot, caustic soda solution is necessary to remove the fat, making the inflation fit for use again. The presence of fat in milking machine liners is probably the chief cause of their deterioration according to Gardner and Berridge[4]. The fat causes softening and swelling of the rubber and greasiness of its surface with consequent rapid deterioration and malfunction.

EXPERIMENTAL PROCEDURE

Milking machine inflations made from neoprene were studied to determine their serviceability as compared with natural rubber inflations. Code letters were assigned to the inflations according to the type of machine on which they were used and according to the kind of material—either neoprene or natural rubber—used in making them.

Eight farms with a total of 25 milking units were furnished with inflations. Two neoprene and two natural rubber inflations were placed on each machine being used in the study. The farmers were told to treat the supplied inflations in the same manner they had been accustomed to treating their own. Washing and sterilizing methods on the selected farms varied widely. Most of the operators said that they did a thorough job after the morning milking although observation did not always confirm this. The evening treatment, with the exception of farm No. 3 where the equipment was thoroughly washed twice a day, usually consisted of a cold water rinse, with a few farms using a sterilizing agent. One, No. 7, did not even rinse his equipment at night if the weather was cool. The sanitation methods and facilities varied from very good on farm No. 3 to very poor on farm No. 7.

On seven of the eight farms, the

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TABLE 1—SWAB TEST BACTERIA COUNTS

	RUBBER					NEOPRENE				
Farm	Type inflation	No. of counts	Log. av. count	Minimum count	Maximum count	Type inflation	No. of counts	Log. av. count	Minimum count	Maximum count
1	A	92	388	0	30,000	I	92	180	0	17,100
2	X	104	299	0	30,000	K	52	63	0	30,000
						L	52	424	0	30,000
3	F	104	163	0	30,000	M	52	75	0	1,500
4	T	24	960	150	3,400	N	52	40	0	1,070
						W	24	111	10	1,080
5	C	92	336	10	13,000	K	142	164	10	12,000
	U	92	343	20	22,700	L	142	202	0	24,600
	E	92	353	0	6,500					
6	T	32	3,427	60	29,000	W	32	1,961	50	22,100
7	B	16	17,130	460	78,000	V	16	12,890	450	58,000
ALL FARMS										
Rubber		648	703	0	78,000	Neoprene	656	297	0	58,000

This farmer discarded 15 rubber inflations but only one neoprene inflation during ten months of tests. Each of his units was equipped with two rubber and two neoprene inflations.

same inflations were swab tested every two weeks. For each neoprene inflation swabbed, a natural rubber inflation on the same unit was swabbed. The swab test solution was then plated, incubated, and the colonies of bacteria counted. This compared the bacterial condition of the two types of inflations, used exactly alike, under identical washing and sterilizing procedures.

Because bacteria might be harbored in minute surface crevices where they would not be collected by swabbing, a search was made for a test that would reveal the degree of retention. Claydon's technique utilized a partial vacuum and the pulsating action of the milking machine in the laboratory to determine the bacteria count of inflations but his equipment was too elaborate for use in the field. A small, portable unit consisting of a vacuum pump, a stall cock, a sanitary trap, and a vacuum controller was constructed for use on the various farms. A pulsator and a claw were connected to the stall cock and by attaching the air tube from the shell to the claw, a pulsating effect was obtained on the inflations just as in the milking operation. Sterile rubber stoppers were placed in the teat openings of the inflations and the inflations were filled with sterile water. The

TABLE 2

	RUBBER						NEOPRENE					
Farm no.	Type inflations	No. of inflations	No. of counts	Log. av. count	Min. count	Max. count	Type inflation	No. of inflations	No. of counts	Log. av. count	Min. count	Max. count
7	B	2	56	54,410	4,000	300,000	V	2	56	34,460	2,100	300,000
5	C	4	72	7,892	200	78,000	L	4	72	3,730	200	177,000

TABLE 3—AVERAGE INCREASES IN WEIGHT AND VOLUME

	Average days use	No. of inflations	Volume increase* ml	Weight increase* gm
Rubber	128	79	14.4	8.0
Neoprene	214	60	1.5	2.1

*Calculated per 100 days use

inflations were pulsated for five minutes and the water was plated, incubated, and counted.

In order to determine the amount of fat absorption, each inflation was weighed before it was placed in use. It was weighed again, when it was removed from service for any reason. To determine the amount of distortion caused by the absorption of fat, or for any reason, the volume was measured before the inflation was placed in use and again when it was removed. The volume was measured to the nearest half milliliter.

From time to time observations were made on the condition of hoses and inflations to detect cracking and checking.

Milking efficiency was also studied to determine comparative performance in terms of time to milk and amount of milk obtained. Two farms were set up for this test. On each farm, one machine was equipped with neoprene inflations and another machine was equipped with natural rubber inflations. On one farm, five cows were selected at random from the herd. The time required to milk them and the quantity of milk given in that time was measured 3 days each week for 3 weeks using the machine equipped with neoprene inflations. The machines were exchanged, and the measurements taken for the natural rubber equipped machines for the same period of time. Since the other farm had only eight cows in lactation at the start of the test (another freshened a week later and was included), the time required for milking and the quality of milk given were measured for both machines. After the 3-week interval, the machines were exchanged and another 3-week period measured.

TABLE 4—REASONS FOR REMOVAL OF INFLATIONS

Reason for removal	Rubber	Neoprene
Worn out	33	0
Accident	4	9
Replaced by other types*	16	10
Tubes enlarged & set	0	3
Total	53	22

*These inflations were still functioning well.

TABLE 5—AVERAGE TIME OF MILKING AND AVERAGE WEIGHT OF MILK PRODUCED

	Rubber—B			Neoprene—V		
	Time		Weight	Time		Weight
Cow	Min.	Sec.	Pounds	Min.	Sec.	Pounds
Trial 1						
No. 1	6	30	24.05	6	17	24.05
No. 2	4	05	15.50	3	44	16.75
No. 3	6	20	29.40	5	24	29.60
No. 4	6	31	23.50	5	39	24.90
No. 5	6	55	23.60	5	26	23.70
Average	6	04	23.20	5	19	23.85
Trial 2						
	Rubber—T			Neoprene—W		
No. 1	8	14	27.90	5	55	27.65
No. 2	5	23	21.90	4	12	22.50
No. 3	6	02	10.20	6	28	9.70
No. 4	6	11	12.90	5	39	13.60
No. 5	7	50	15.90	7	40	16.50
No. 6	6	23	9.45	6	21	8.95
No. 7	3	46	16.15	3	46	15.20
No. 8	6	24	13.20	6	32	13.25
No. 9	4	05	19.95	4	48	21.50
Average	6	10	16.15	5	42	16.45

RESULTS AND DISCUSSION

The logarithmic averages of the swab tests are given in Table 1. An examination of this table shows the wide variation in count both between the two types of inflations and between the different farms. Only one type of neoprene inflation, L, had higher bacterial counts than its rubber comparisons.

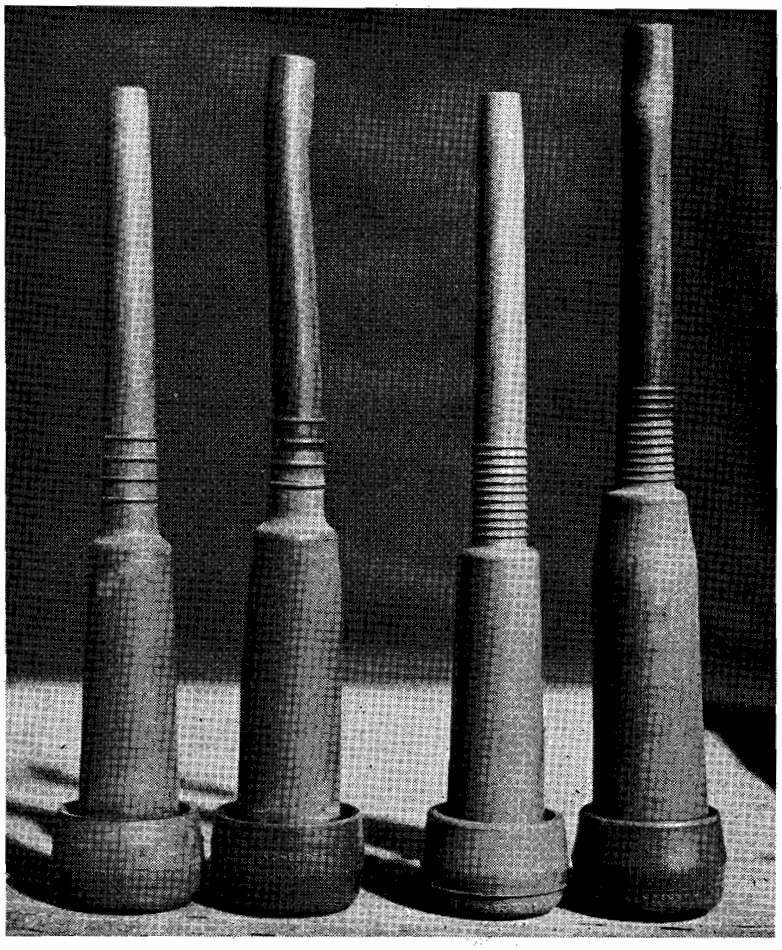
The results of the swab tests show that usually there were about twice as many bacteria removed by the swab from natural rubber as from neoprene.

The results indicate that neoprene is usually more effectively cleaned and sterilized than natural rubber under the same conditions. On the farms where the best conditions of cleaning and sterilizing prevailed the neoprene proved far superior to natural rubber in terms of the number of bacteria recovered.

Dynamic tests using the modified Claydon technique were made on 2 inflations of neoprene and 2 of natural rubber on one farm, and 4 inflations of each on another farm to determine if this method would give differing or more reliable figures. The results of these tests are given in Table 2. This table shows neoprene inflations were bacteriologically superior to natural rubber inflations in this series of tests.

A milking machine inflation absorbs fat, and, in so doing, becomes distorted. The added fat increases the weight of the inflation, the distortion changes its volume and milking efficiency. The increases in volume and weight of the inflations are shown in Table 3.

The rubber inflations averaged almost ten times the increase in volume and almost four times the increase in weight of the neoprene. It was observed that increases in weight and volume were much more marked in the later stages of use and, since many of the natural



New Neoprene Old Neoprene 231 days New Rubber Old Rubber 231 days

Relative increase in length of Neoprene and Rubber inflations after use. Note distortions of body and tube ends.

rubber inflations were removed because of malfunction in less than 100 days, the data are somewhat biased in favor of the natural rubber. A number of natural rubber inflations which were used for 170 days showed values for volume increase of more than 35 ml and weight increases of more than 15 gm.

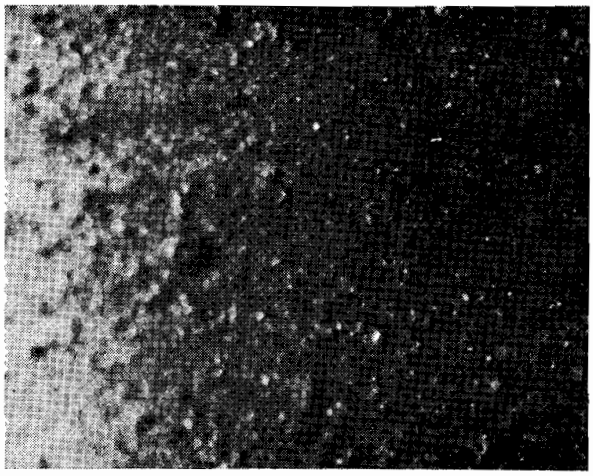
More rubber inflations were studied because their shorter life required more replacements.

During the time of this study, 53 natural rubber inflations were replaced as compared with 22 neoprene inflations. The reasons for replacement are shown in Table 4.

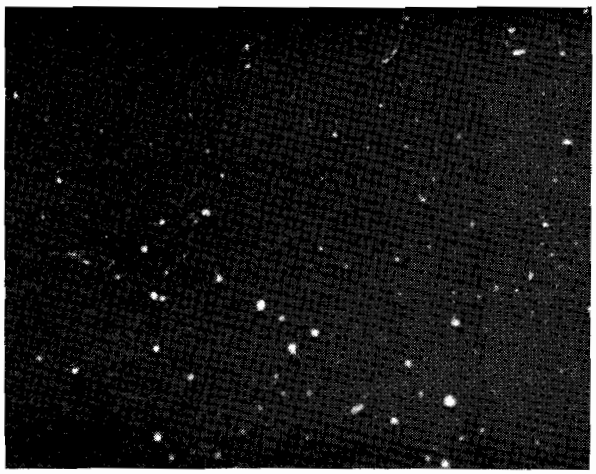
Three of the neoprene inflations, after extended use, had lost elasticity in the narrow tube, to a point where they would not cling tightly to the claw.

Farms No. 4 and No. 7 were used for the efficiency test, farm No. 7 being studied first. The average weight of milk produced per milking and the average time required to milk is given in Table 5. The weight of milk produced would be expected to remain the same or decline slightly as the test progressed. The table shows this to be true leaving the time of milking the only factor to be considered. On farm No. 7, the vacuum line became partially plugged resulting in an extremely long time of milking for cows No. 1 and No. 4. on the seventh day the machine equipped with neoprene inflations was used. Cow No. 5 required an extremely long time to milk on two occasions. No reason for this was ever determined.

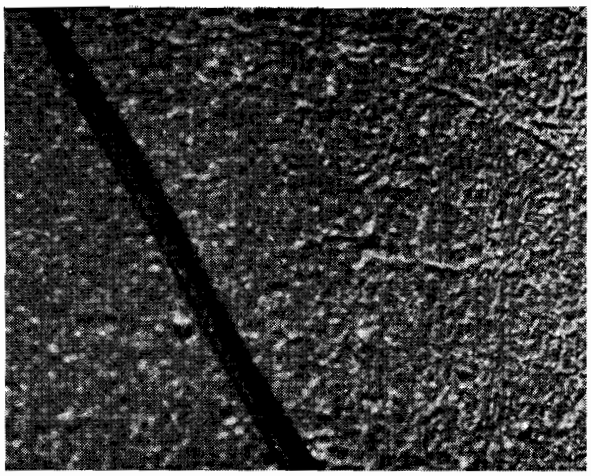
On farm No. 4, cows No. 1, No. 2, No. 4, No. 5, and No. 8 were milked with the machine equipped with neoprene inflations the first three weeks, and then with the machine equipped with natural rubber inflations. Cows No. 3, No. 6, No. 7, and No. 9 were milked with the rubber-equipped machine the first three weeks, followed by the neoprene equipped machine. As on farm No. 7, the weight of the milk produced was about as expected allowing for the natural decrease as the period of lactation advanced. There were two exceptions to this.



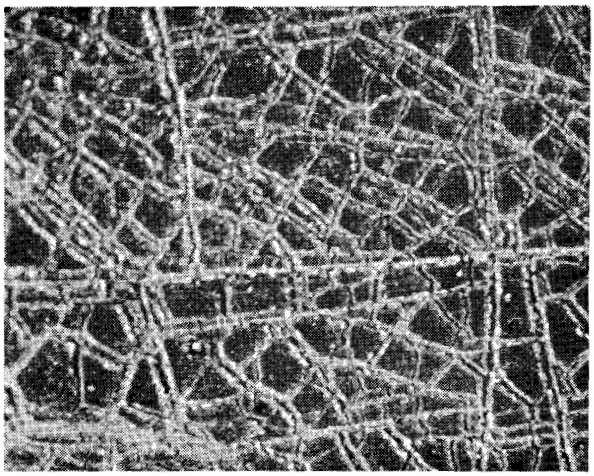
New Neoprene



New Rubber

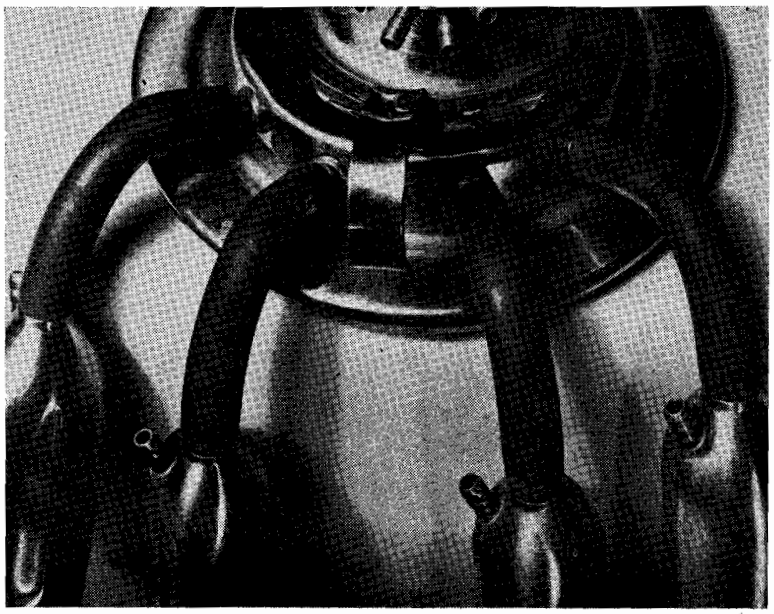


Old Neoprene (300 days use)



Old Rubber (172 days use)

A comparison of surface conditions of liners. The line across the picture of old neoprene is a human hair. All pictures 30 X magnification.



Neoprene Rubber Neoprene Rubber

Neoprene and Rubber inflations showing cracking of the material after one hundred sixteen days of regular use.

Cow No. 1 had just freshened when the experiment started, and required stripping by hand the first two weeks that the neoprene-equipped machine was used on her. Also, the last two days that each machine was used on her, she was slow in milking due to a foot-rot infection. Cow No. 9 freshened the second week of the experiment, and was hand stripped for three milkings while being milked with the rubber equipped machine.

The neoprene-equipped machine milked the cows faster on all tested on farm No. 7, ranging from 13 seconds faster on cow No. 1 to 1 minute and 29 seconds faster on cow No. 5. On farm No. 4, the neoprene-equipped machine was faster on five of the nine cows, and the time was the same on one cow. The present data give the impression that a milking machine equipped with neoprene milks faster than one equipped with natural rubber. However, these data are not extensive enough to arrive at any conclusions.

CONCLUSIONS

1. Under the same conditions of cleaning and sterilizing the bacterial counts of neoprene inflations were better than those of natural rubber inflations.

2. Neoprene inflations develop less distortion than rubber inflations in field use, because of greater resistance to fat absorption.

3. Neoprene inflations have approximately 2 times the service life of rubber inflations.

4. Neoprene inflations were more efficient in the milking operation than natural rubber inflations in a limited series of tests.

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