MilkTech International

UW-MRIL

The Milking Unit

An introduction to Teatcup Liners

1

Objectives

- Describe some basic characteristics and dimensions of teatcup liners
- Introduce terms commonly used to describe liners and their component parts
- Show some general effects of liner dimensions on milking characteristics

2

Teatcup Liners are…

- … soft rubber or silicon sleeves which are mounted in a rigid shell.

3

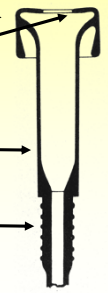
Teatcup Liners are…

- … the only parts of the machine that touch the teats of the cows.

4

Liner Terminology

- Primary components of teatcup liners:
  - Mouthpiece
  - Mouthpiece lip
  - Barrel
  - Short milk tube



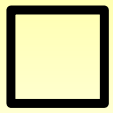
5

Liners can be classified by:

- Barrel shape:
  - Round
  - Square
  - Triangular
- Type of manufacture
  - Molded
  - Extruded
  - One- or two-piece designs
- Composition
  - Natural rubber
  - Synthetic rubber

6

Barrel Shapes (cross-section)



Square

Round

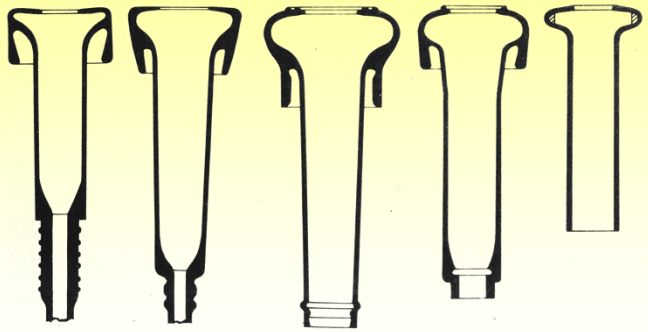
Triangular

7

Examples of Liners

8

Examples of liner shapes



Adapted from C.C. Thiel et al. 1977

9

Liner composition

- Natural Rubber
  - Hevea brasiliensis tree (Amazon, Brazil)
  - Cis-polyisoprene chains
  - Vulcanization cross-links chains (hardens)
  - Expected life: 600 – 800 cow-milkings

10

Composition

- Synthetic Rubber
  - All non-natural rubber, and natural/synthetic rubber blends
  - Offer improved wear, oil, chemical and oxidation resistance
  - Expected life:
    - Natural/nitrile blends: 2500 cow-milkings
    - Silicon: 3000 – 5000 cow-milkings

11

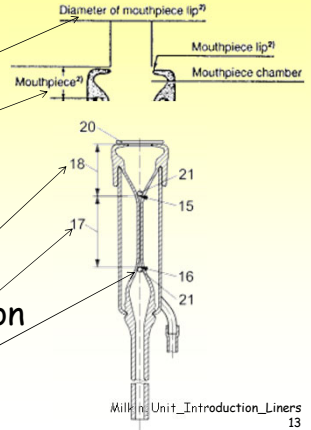
Effects of storage, age and use on expected life of liners

- Physical shape, tension and surface condition change gradually as liners age.
  - The rate of change in liner properties depends on:
    - ✓ The use rate (cows milked per day)
    - ✓ Effectiveness and frequency of cleaning
    - ✓ Storage conditions
- These physical changes affect milking characteristics.

12

Liner Geometry

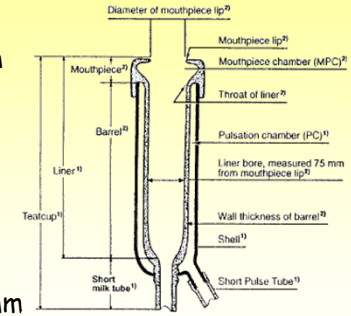
- Mouthpiece
  - Diameter
  - Cavity height
  - Wall Thickness
  - Mouthpiece depth
  - Zone of compression
  - Lower touchpoint



13

Geometric Differences

- Liner bore
  - Varies from 18 to 30 mm
  - 'Wide-bore': > 24 mm
  - 'Narrow-bore': < 21 mm
- Liner taper
  - Upper barrel diameter minus liner bore @75 mm
    - ✓ Non-tapered: 1 – 2 mm
    - ✓ Tapered: > 2 mm



14

Geometric differences

- Liner elongation
  - Liners mounted under tension
    - ✓ 90 – 164 mm
    - ✓ Stretched by 5-15%
  - Liners stretch and lose tension with age and with use
    - ✓ Compare length of used liner to new.
    - ✓ Use standardized test apparatus to compare force needed to stretch a used liner compared with new liner.

15

Some examples of liner dimensions from around the world

Liner characteristic	Bou-Matic R1C, USA	SAC Uniflow, Denmark	DairyMaster, Ireland
Mid-barrel bore (mm)	19	22	25.6
Upper barrel bore (mm)	21.1	23.5	31.6
MP lip diameter (mm)	19.8	22	23
Ratio mid-bore:MP lip	0.96	1	1.11
MP cavity height (mm)	22	24	28.6
Limits of liner collapse zone (mm) measured from top of mouthpiece	32 (upper collapse point) to 145 (lower collapse point)	35 (upper) to 152 (lower)	45 (upper) to 151 (lower)

16

Liner dimensions from around the world

- Comparing the three liners in the previous slide, the Bou-Matic liner has:
  - Smallest mid-barrel bore, upper barrel bore, mouthpiece cavity height, lowest mid-barrel to mouthpiece lip diameter ratio
  - All of these features help to minimize teat congestion.

17

Liner dimensions from around the world

- Comparing the same three liners, the Irish liner has:
  - Largest mid-barrel bore, upper barrel bore, mouthpiece cavity height, mid-barrel to mouthpiece lip diameter ratio
  - All of these features help to minimize slip and fall-offs.

18

Liner design influences

- Milk yield per milking
- Average milking time
- Mean stripping yield
- Frequency of liner slips, cluster falls, kick-offs
- Effectiveness of pulsation
- Teat condition

19

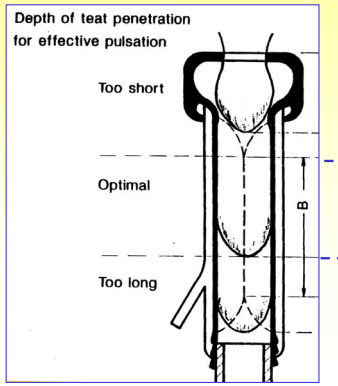
Some effects of liner dimensions on milking characteristics

Dimensional change (eg. by 10%)	Milking speed	Strip Yields	Cup slips or falls	Teat congestion
Mid-barrel bore is increased	1	👎	👍	👎
Upper-barrel bore is increased		👎	👍👍	👎👎
Ratio of mid-barrel bore to MP lip diameter is increased		👎👎	👍👍	👎👎
MP lip is made thicker		👎	👍	👎
Effective collapsed length is increased	2			2
Liner tension increased			👎	👎
Liner wall thickened	3			
Bore of short milk tube increased	4			

1 No further benefit once the mid-barrel bore exceeds the average diameter of the teats in the herd.
2 Little of no further benefit once EL exceeds guidelines previously presented
3 Little or no further benefit above a wall thickness of about 2.2 mm
4 No further benefit above about 11-12 mm bore

20

Effective pulsation depends on liner dimensions relative to the average teat length within a herd



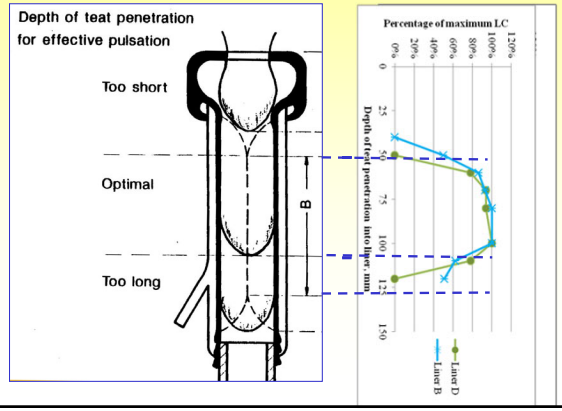
Pulsation fails when short teats are milked in liners with a deep MP chamber

Zone of compression applied to teat-end by the closed liner

B = ISO definition of 'Collapse length of liner'

21

Compression applied to teat-ends by a closed liner (LC) varies markedly with depth of penetration of teat into the liner



22

Summary

- Liners come in many shapes and sizes.
- Liner material influences liner life.
- Liner design strongly influences milking characteristics
- Liner design involves making compromises between milking speed, completeness of milking, frequency of liner slips, and teat condition.

23