Initial Studies of Teat Spray Application for Disinfection

Colin Kingston, Richard Hiley. Ambic Equipment Limited, Witney, OX28 4YF, Oxon, England.

1. Aim of the work

To identify teat spraying performance factors and design criteria that could enhance mastitis prevention routines by :

- **Optimising teat coverage**
- **Minimising chemical wastage**
- **Improving operator safety and human health**

2. Introduction

- **Disinfectant sprays are commonly used in udder hygiene management programmes**
- **This study examined:**
  - ***The droplet size distribution produced***
  - ***The establishment of a pulsed spray cloud***
  - ***The deposition of spray on to an udder***

3. Measurement of droplet size

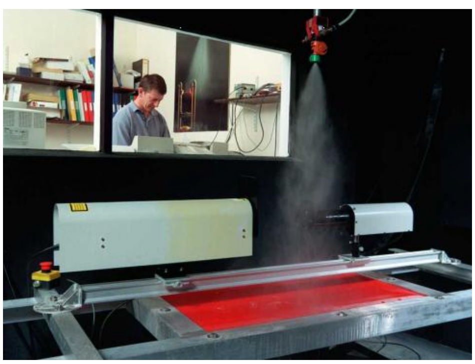


Figure 1. Droplet size measurement

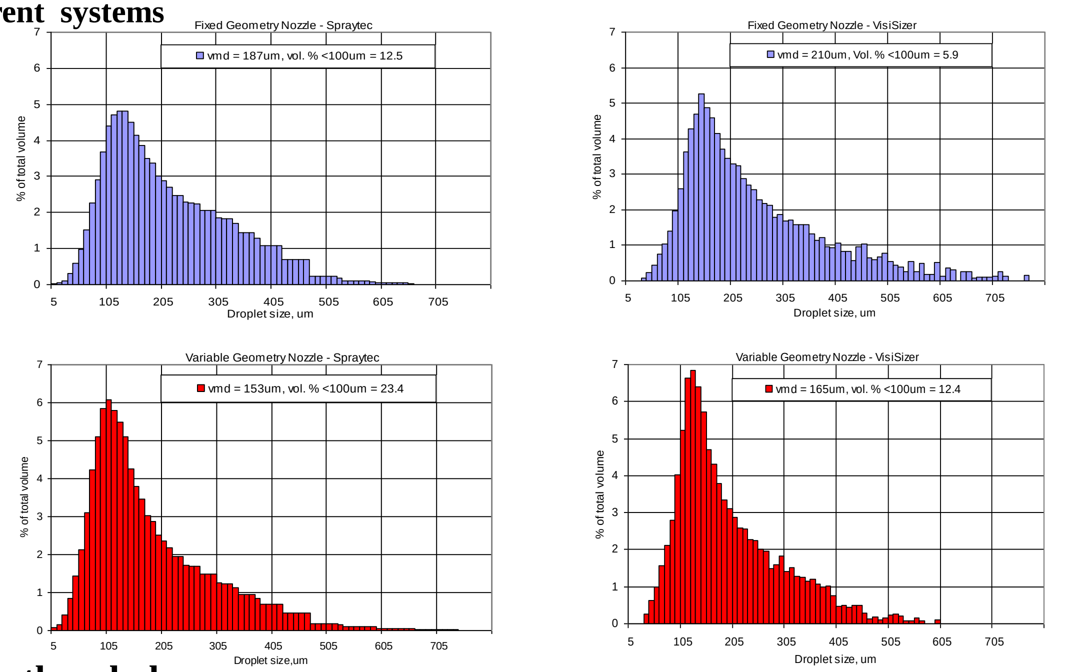
- **Using laser-based measuring instruments**
  - Malvern Instruments "Spraytec"
  - Oxford lasers "Visisizer"
- **Two nozzle types**
  - Fixed geometry cone
  - Variable geometry hollow cone
- **Three pressures**
  - 40, 50 & 60 psi (2.76, 3.45 & 4.14 bar)
- **To obtain data for the whole spray, parts of the spray and the variation with time.**

Results

Summary of the measured droplet sizes in the whole spray for the two nozzles operating with three liquids at a pressure of 50 psi (3.45 bar), - means of three replicates made with the Malvern Instruments "Spraytec" unit

Nozzle geometry	Liquid	Flow rate		Dv_{50} µm	% spray volume <100 µm diameter
		US gal/min	L/min		
Fixed	Water	0.196	0.743	195.9	10.9
Fixed	Disinfectant A	0.202	0.766	187.5	12.6
Fixed	Disinfectant B	0.201	0.762	282.3	7.1
Fixed	Disinfectant C	0.200	0.758	322.9	5.7
Variable	Water	0.165	0.623	155.6	25.8
Variable	Disinfectant A	0.167	0.633	155.4	25.9
Variable	Disinfectant B	0.169	0.639	230.5	16.7
Variable	Disinfectant C	0.169	0.640	257.2	13.7

Figure 2. Typical volume distributions for the whole spray cloud for the fixed and variable geometry nozzles spraying 0.1% Agral solution at 50 psi and 200 mm height measured with the different systems



For the whole spray:

➢ Sprays from the variable geometry nozzle were finer with a lower v.m.d. and a higher percentage of spray volume in droplets <100mm in diameter

➢ Good agreement between instruments although the sample from “Spraytec” gave higher values for spray volumes <100mm in diameter due to a lower threshold size

➢ Disinfectant formulation influences spray formation

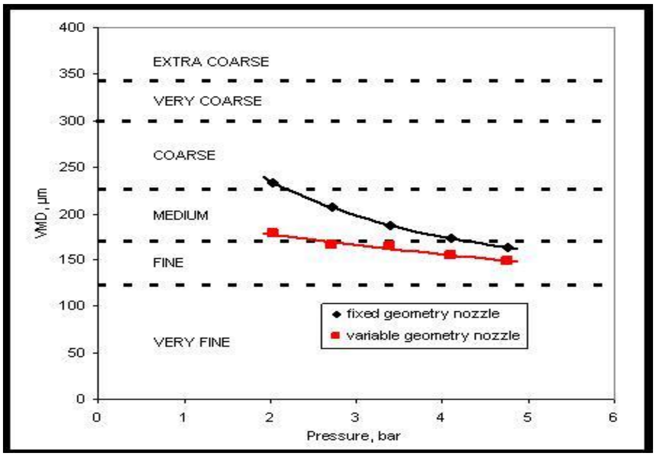
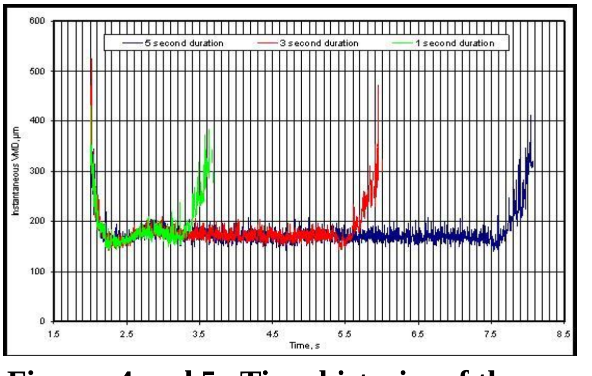
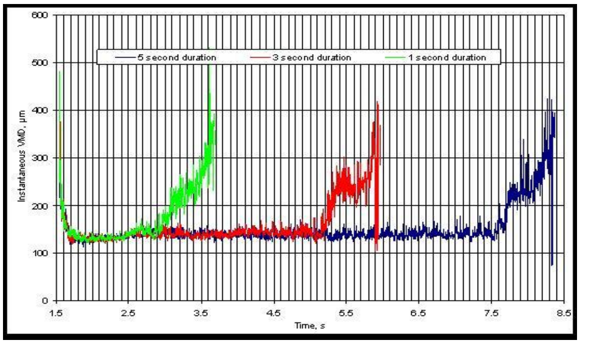


Figure 3. Mean droplet sizes from the two nozzles over a range of operating pressures



Figures 4 and 5. Time histories of the mean droplet sizes for three pulse durations spraying 0.1% Agral solution through the fixed nozzle (above) and variable geometry nozzle (below) measured 200 mm from the nozzle with the Malvern Instruments “Spraytec”



For the pulsed spray:

➢ Spray establishment was rapid – stable mean size in circa 0.15 s

➢ Some small droplet fall back through the measurement volume particularly with the variable orifice nozzle giving the finer spray.

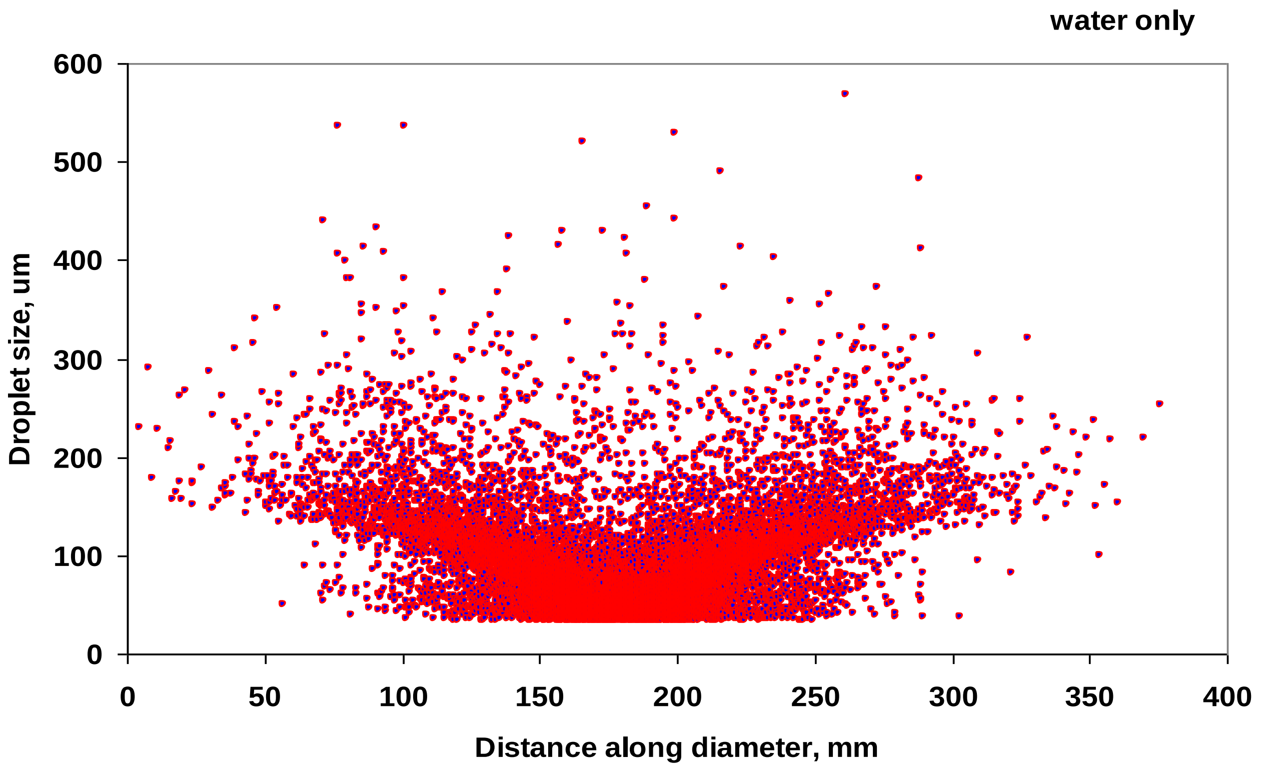


Figure 6. Spatial distribution of droplet sizes along a diameter through the spray from the fixed nozzle spraying water at 50 psi (3.40 bar)

4. Measurement of deposits on a simulated udder

➢ **Using tracer dyes and chromatography paper on teats**

➢ **lance movements typical of practical operation**

Results

- Show considerable variation due to manual nozzle movement
- Indicate scope to increase total recoveries
- Do not account for real surface conditions

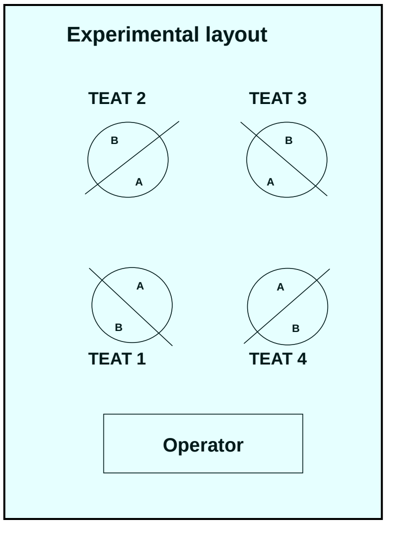


Figure 7. Sampling layout on simulated udder

5. Summary of main findings

- **Spray patterns vary with chemical as a consequence of differences in viscosity and surface tension.**
- **Routines adopted by the operator influence spray deposition patterns.**
- **A coarser spray (vmd of circa 200 µm) from the fixed nozzle gave higher deposition than the finer sprays from the variable geometry nozzle.**
- **The trigger valve/nozzle assembly design gave a rapid establishment and collapse of the spray.**
- **Droplets less than 100 µm should be avoided to safeguard operator health.**

The work reported was conducted by Silsoe Spray Applications Unit (part of The Arable Group) in the UK