Design consideration on the drainage piping system using less water for WC flushing

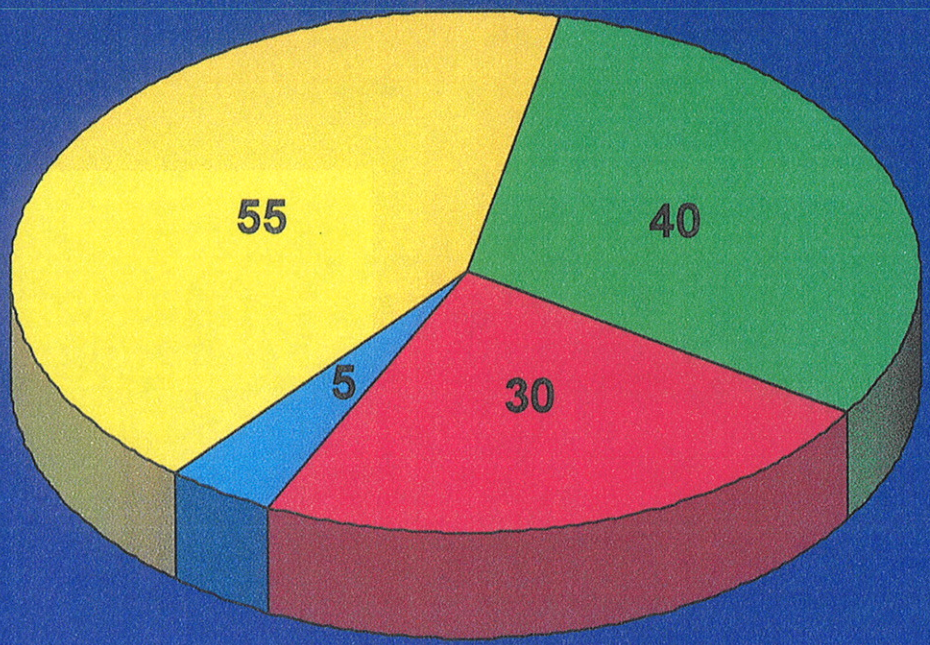
Water saving ; Design consideration on the drainage piping

Contents

- Introduction to water saving strategies
- Situation US and Europe
- Geberit solution realization
- Drain booster
- Conclusions

Introduction to water saving strategies

Daily water consumption in Germany

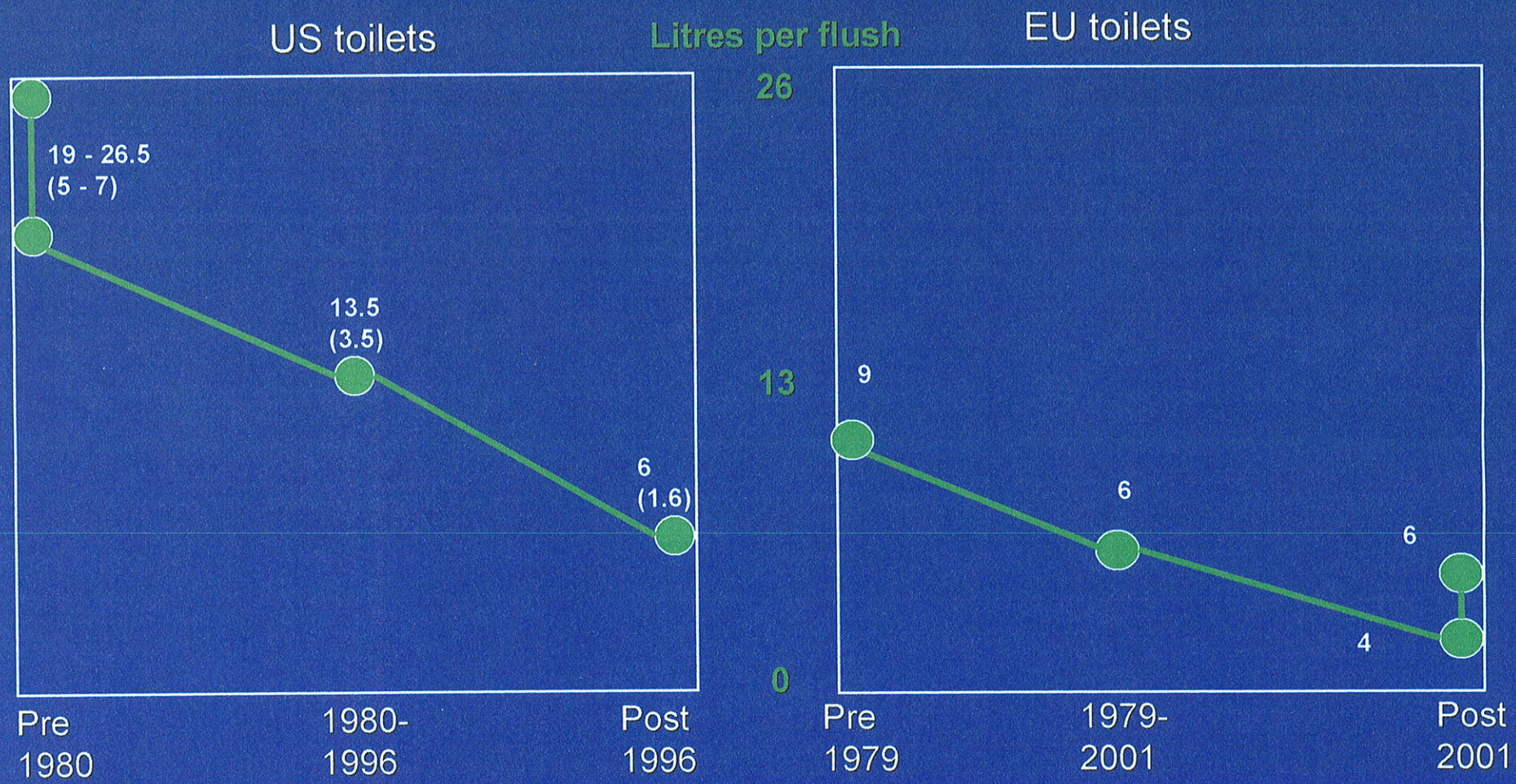


Total: 130 litres / person and day

Source BGW

Situation in US and Europe

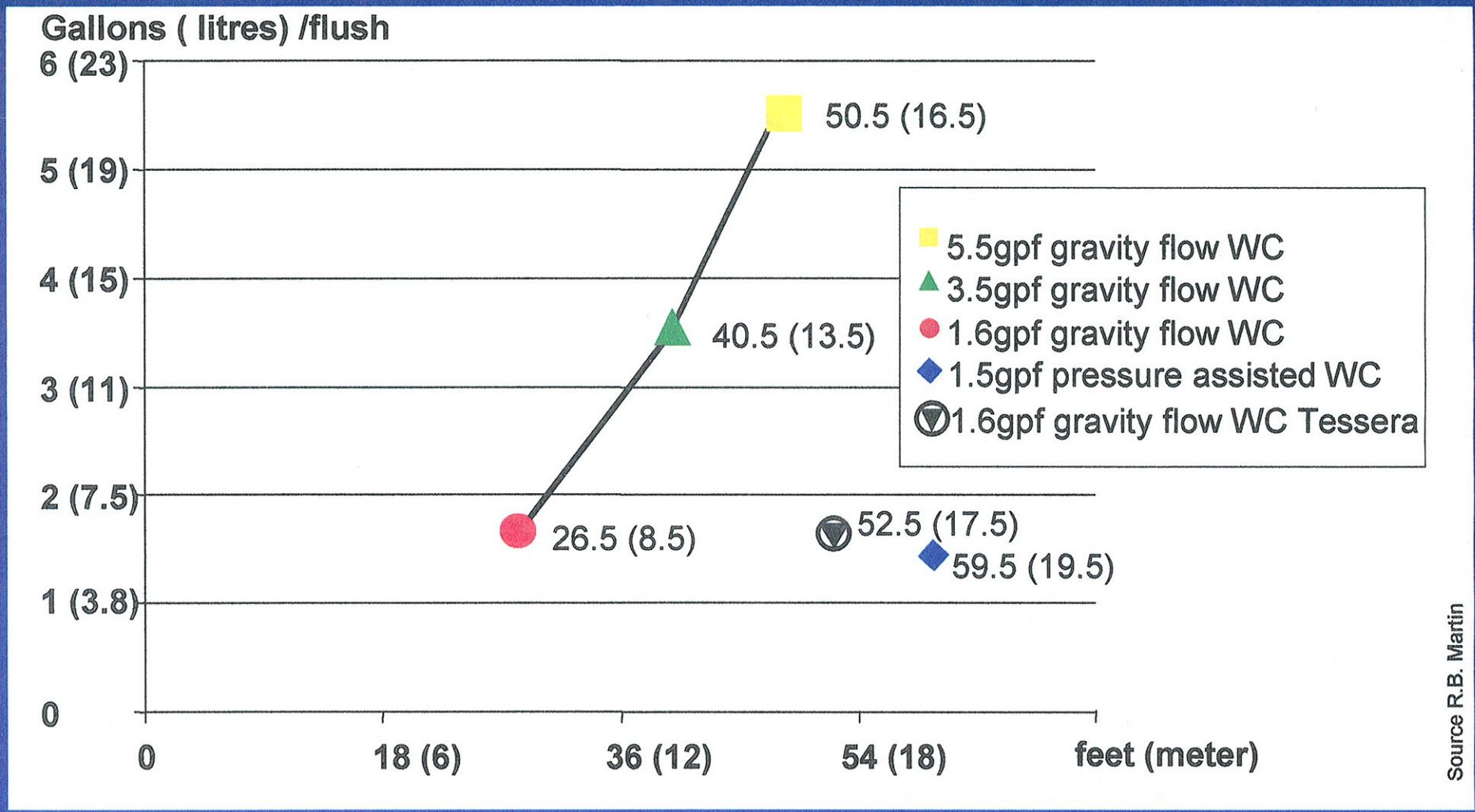
Water reduction on toilets



GEBERIT

Situation US and Europe

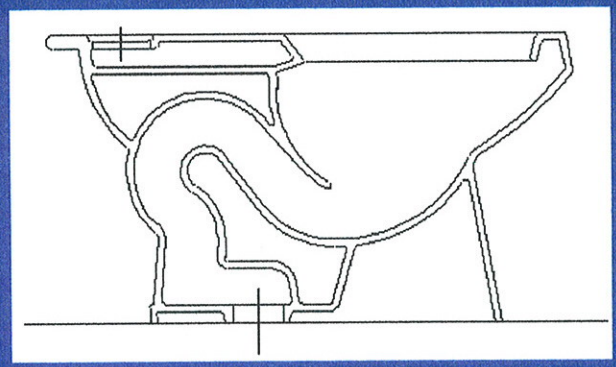
High performance despite low water



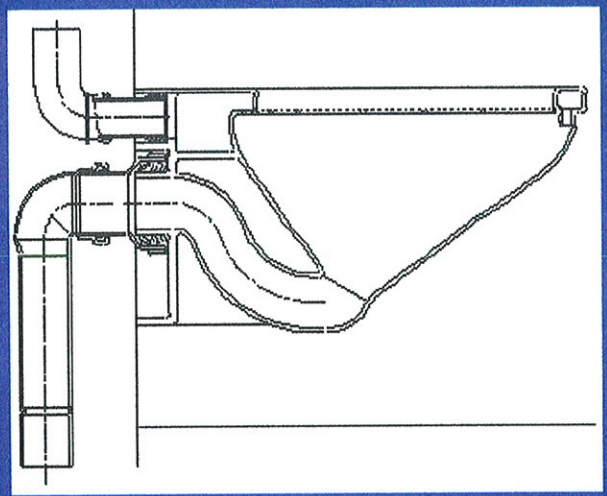
Situation US and Europe

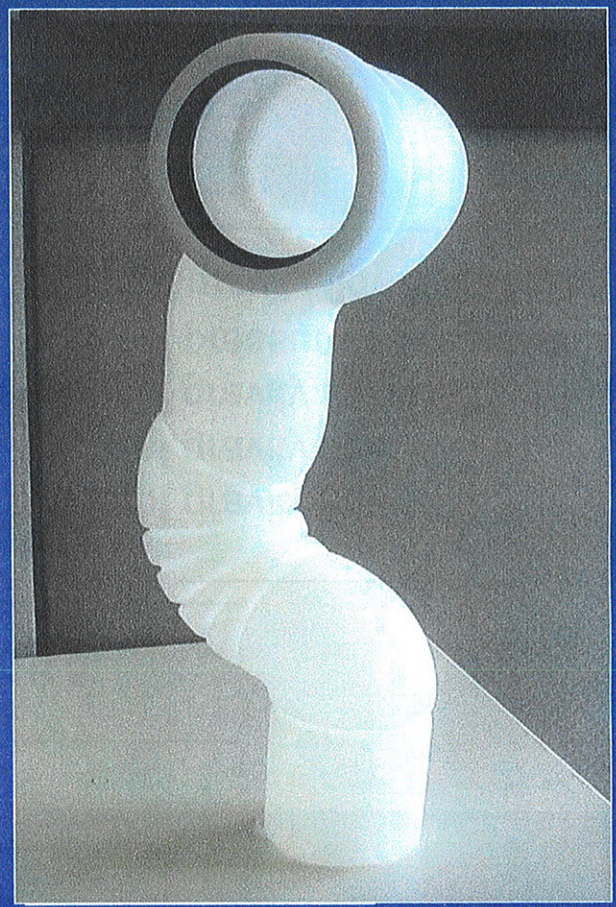
Geberit US solution Tessera toilet system

Conventional floor mounted



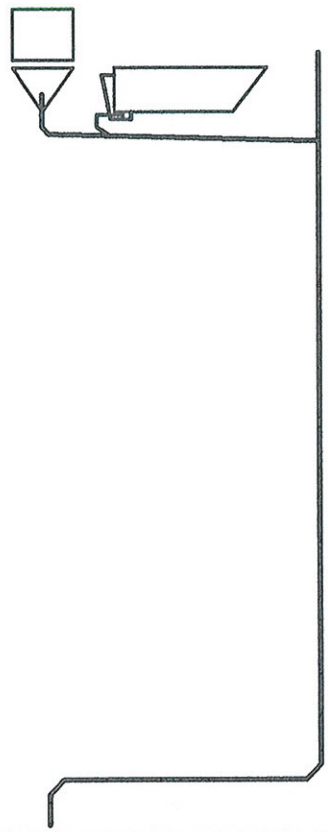
Tessera wall hung with separated trapway





Situation US and Europe

European Standard EN 12056 The new approch in water saving



Water saving : ➡ **WC 4 litres flushing**

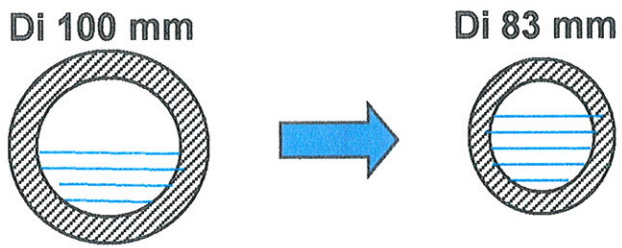
Stack : ➡ **DN 80(75) and DN 90(79) possible**

Swept entry : ➡ **More hydraulic capacity More Discharge Units (DU) possible**

Drain line : ➡ **DN 80(75) and DN 90(79) possible**

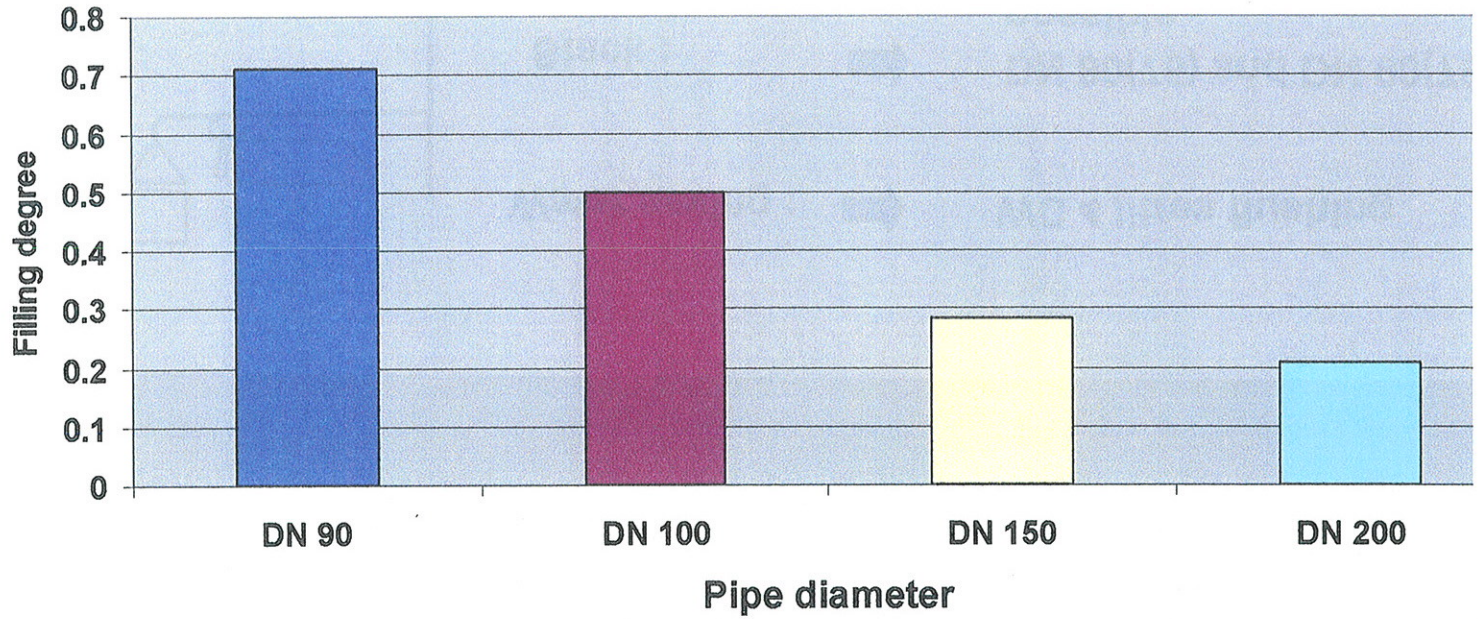
Geberit solution realization

High performance despite low water European solution



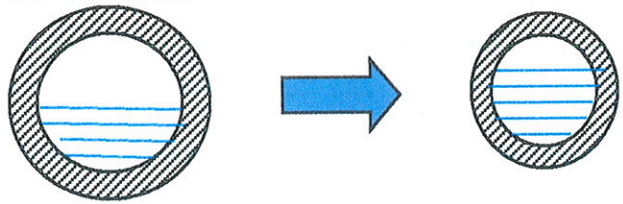
Reduction of diameter
⇨ Higher filling degree
⇨ Higher transport distance

Filling degree at 2 l/s flowrate



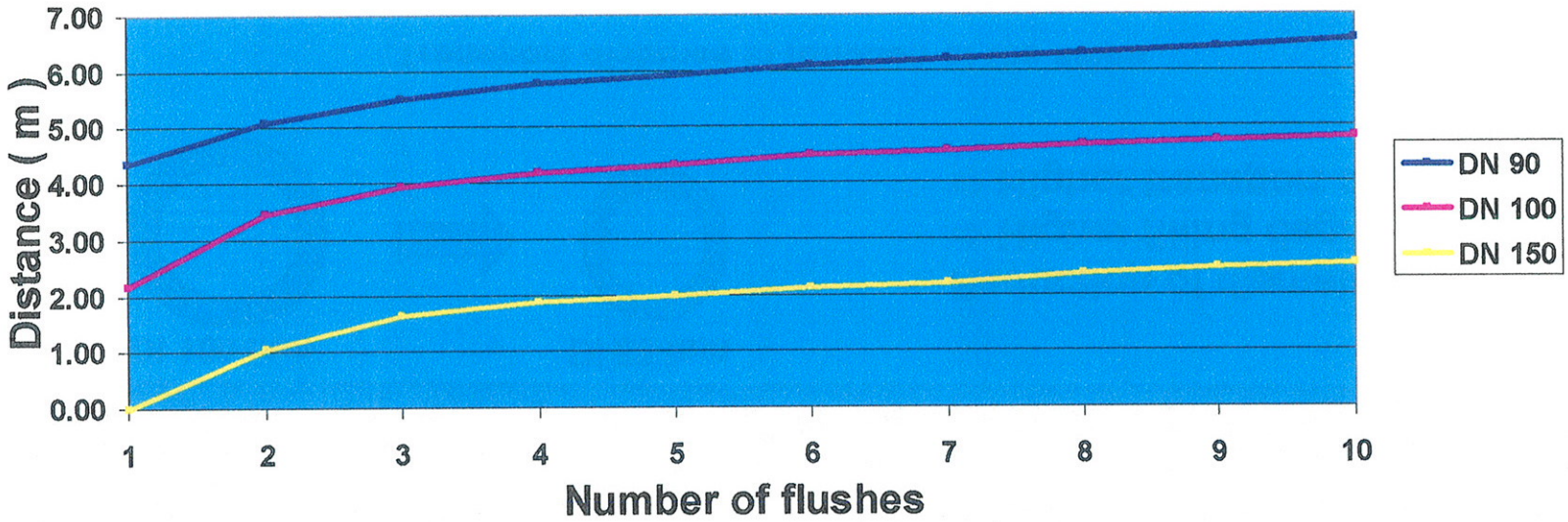
Geberit solution realization

High performance despite low water European solution



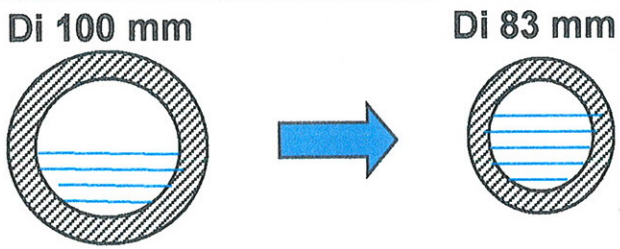
Reduction of diameter
⇨ Higher filling degree
⇨ Higher transport distance

Transport distance in drain lines

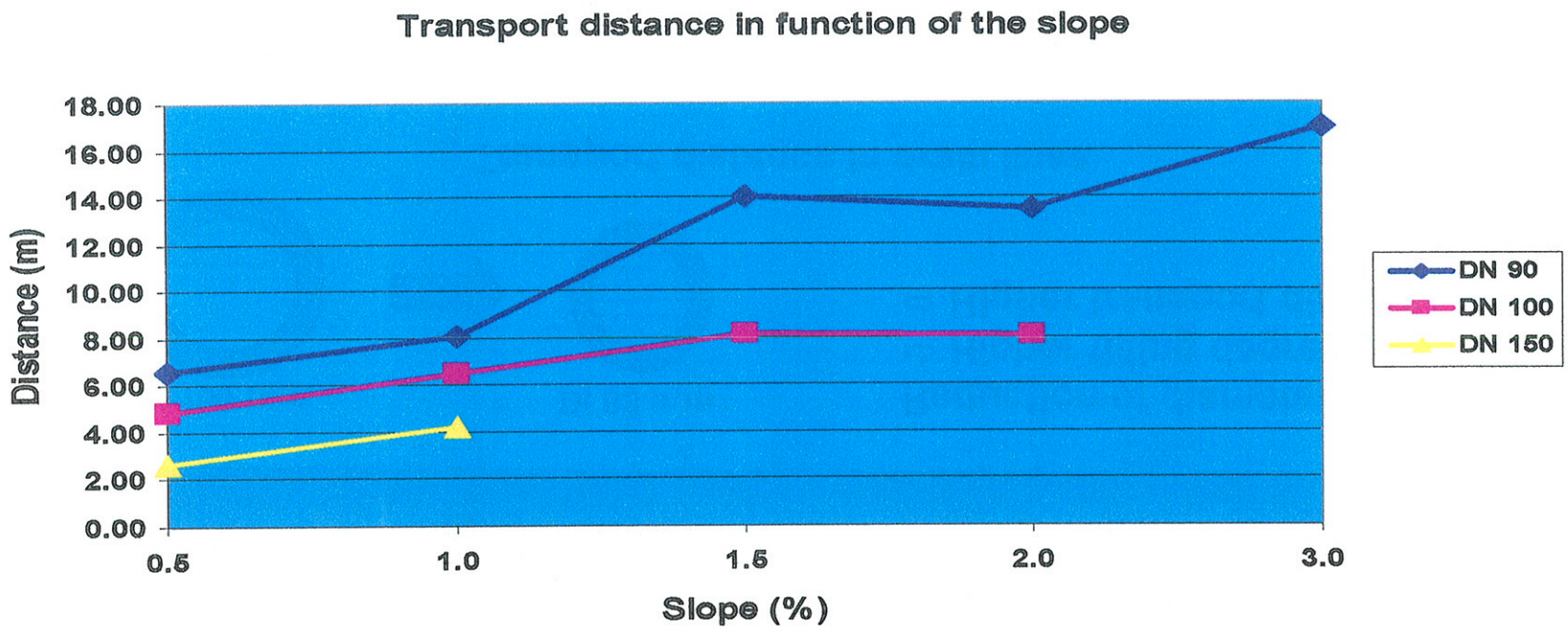


Geberit solution realization

High performance despite low water European solution



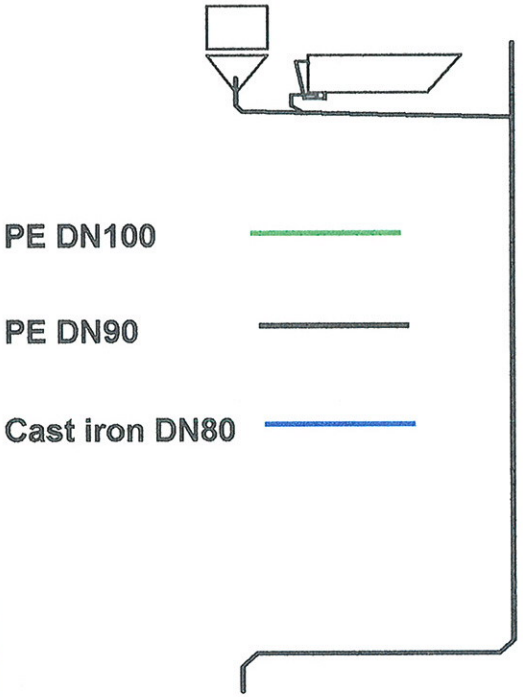
Reduction of diameter
⇨ Higher filling degree
⇨ Higher transport distance

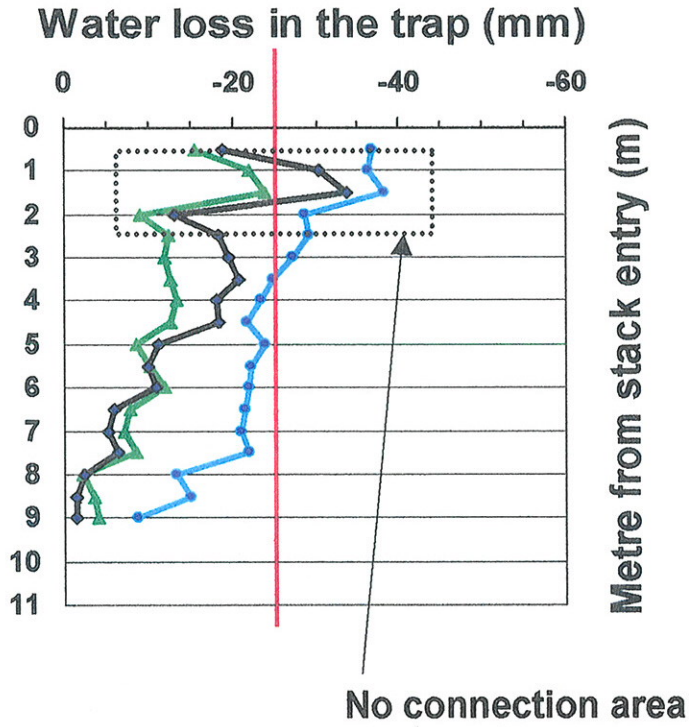


Geberit solution realization

Stack DN 90 and swept entry fitting

Pressure distribution in the stack due to discharge height, discharge and shape of inlet





Geberit solution realization

High performance despite low water European solution

EN 12056 Gravity drainage system inside buildings

Stack	Capacity Q_{max}		
DN (mm)	Square entry	Swept entry	Σ DU
80	2.0	2.6	27
90	2.7	3.5	49
100	4.0	5.2	108
125	5.8	7.6	231
150	9.5	12.4	615
200	16.0	21.0	1764

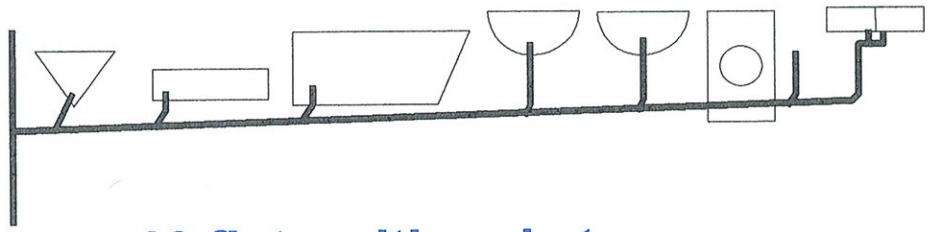
Discharge units (DU) ; Q_{max} = 0.5*SQR(ΣDU)

Geberit solution realization

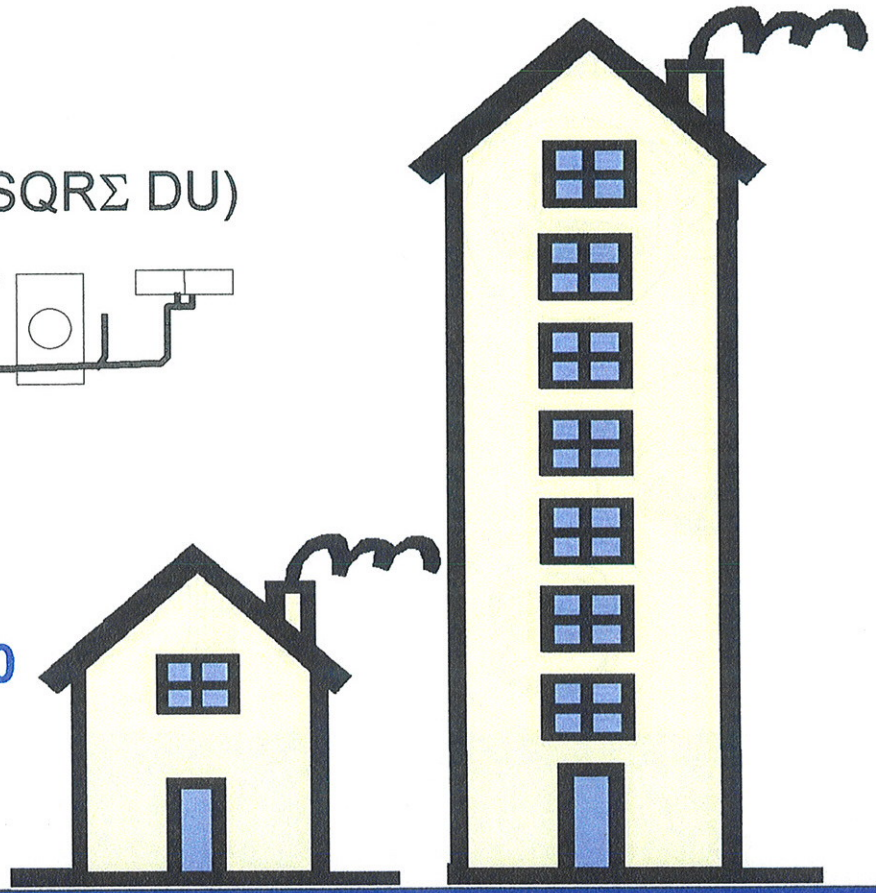
The new approch in water saving

Calculating example

- vented stack
- flowindex 0.5; (Q_{max}=0.5*SQRΣ DU)



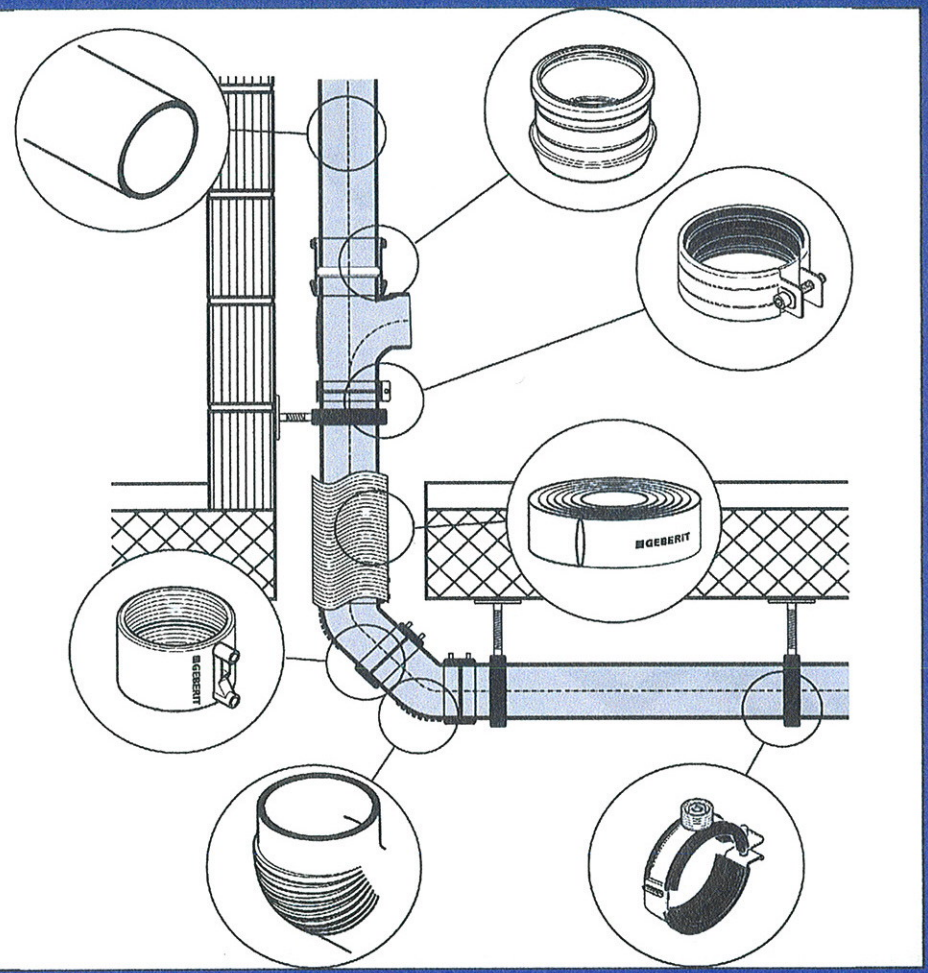
16 flats with only two dimensions
db20 - DN56 und DN90



Geberit solution realization

The new approach in water saving

Noise control:	**PE with increased wight**
	Solidborne sound insulation
Negative: pressure control	**Swept entry stack fitting**
Transport: capacity control	**Reduced diameter DN 90 mm**

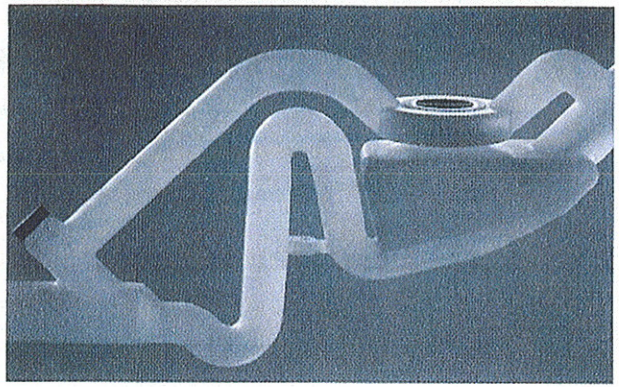


Drain booster

High performance despite low water and large diameter of the drain line

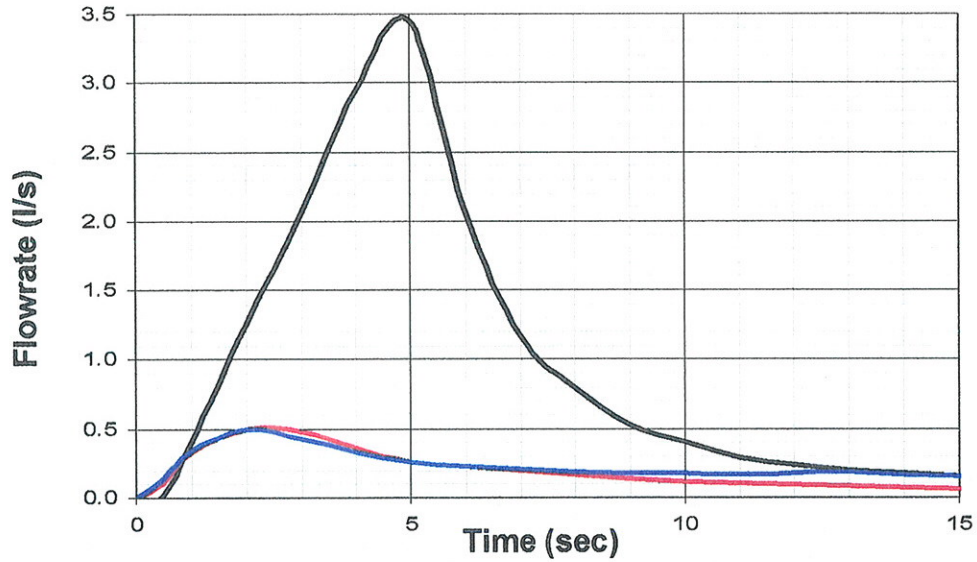
Flush peak in the drain line

- Booster - as a solution



Drain flow line 5m after the stack

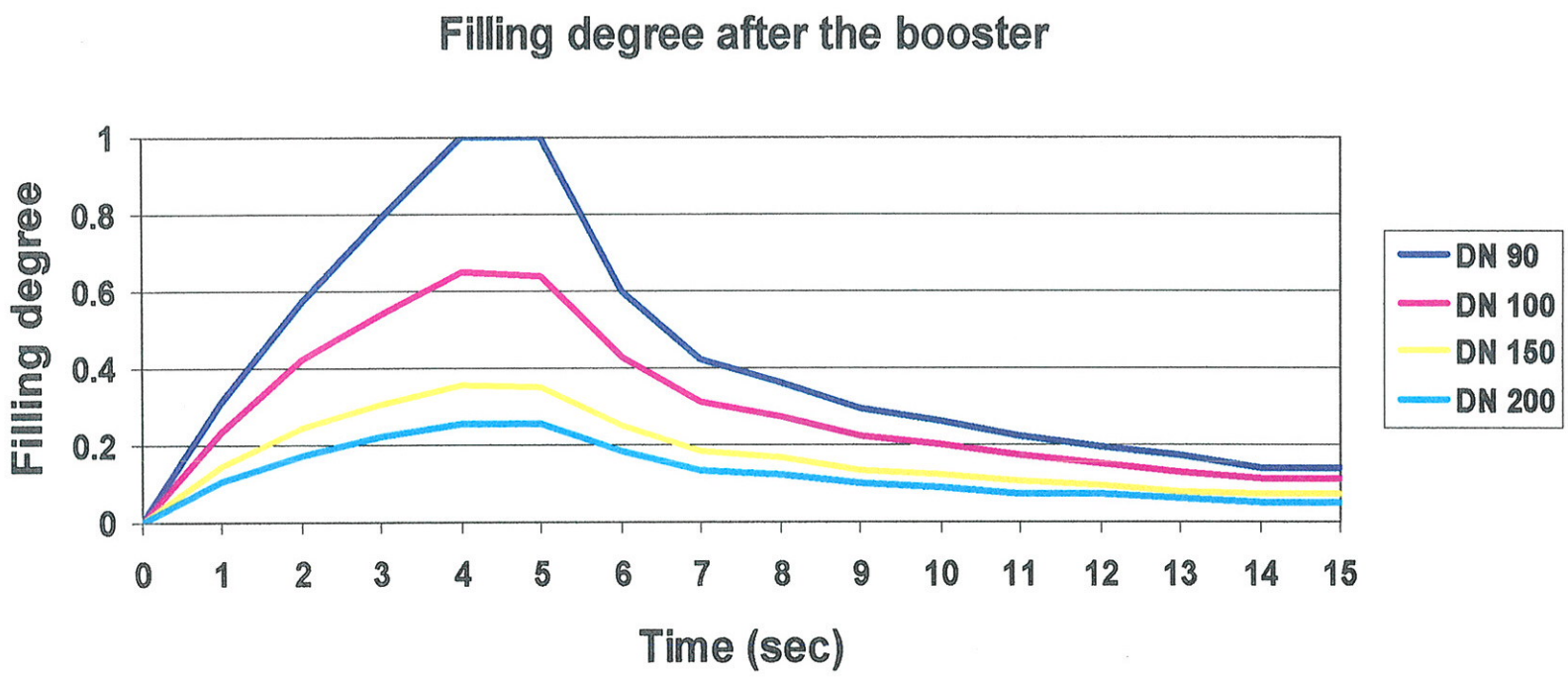
- Booster
- D_i 100
- D_i 83



Drain booster

High performance despite low water and large diameter of the drain line

Filling degree in the drain line after the booster



Water saving ; Design consideration on the drainage piping

Conclusions

- Watersaving plus good performance is possible
- Performance despite low water needs new approaches
- New concepts open new solutions
- In depth research bewares of negative side effects
- Water saving at the cutting edge? Yes....But the edge is moving



Pierre Juple
Geberit Technik AG
Jona, Switzerland
pierre.juple@geberit.com

Demonstration at the drainage piping set up

Transport capacity of a 4.5 liter WC flush

Stack Nr.1	**Discharge stack dim 100**	➡	**Drainline dim. 150**
Stack Nr.2	**Discharge stack dim 100**	➡	**Drainline dim. 100**
Stack Nr.3	**Discharge stack dim 75**	➡	**Drainline dim. 75**
Stack Nr.4	**Discharge stack dim 100**	➡	**Drainline dim. 200**

Setsco Findings on the Proposed Sanitary Drainage System

Design Consideration on the Sanitary Drainage System

By Dixon Ng

Setsco Findings of Proposed Sanitary Drainage System

- Introduction
- Procedure
- Results
- Discussion

Setsco Findings of Proposed Sanitary Drainage System

Introduction

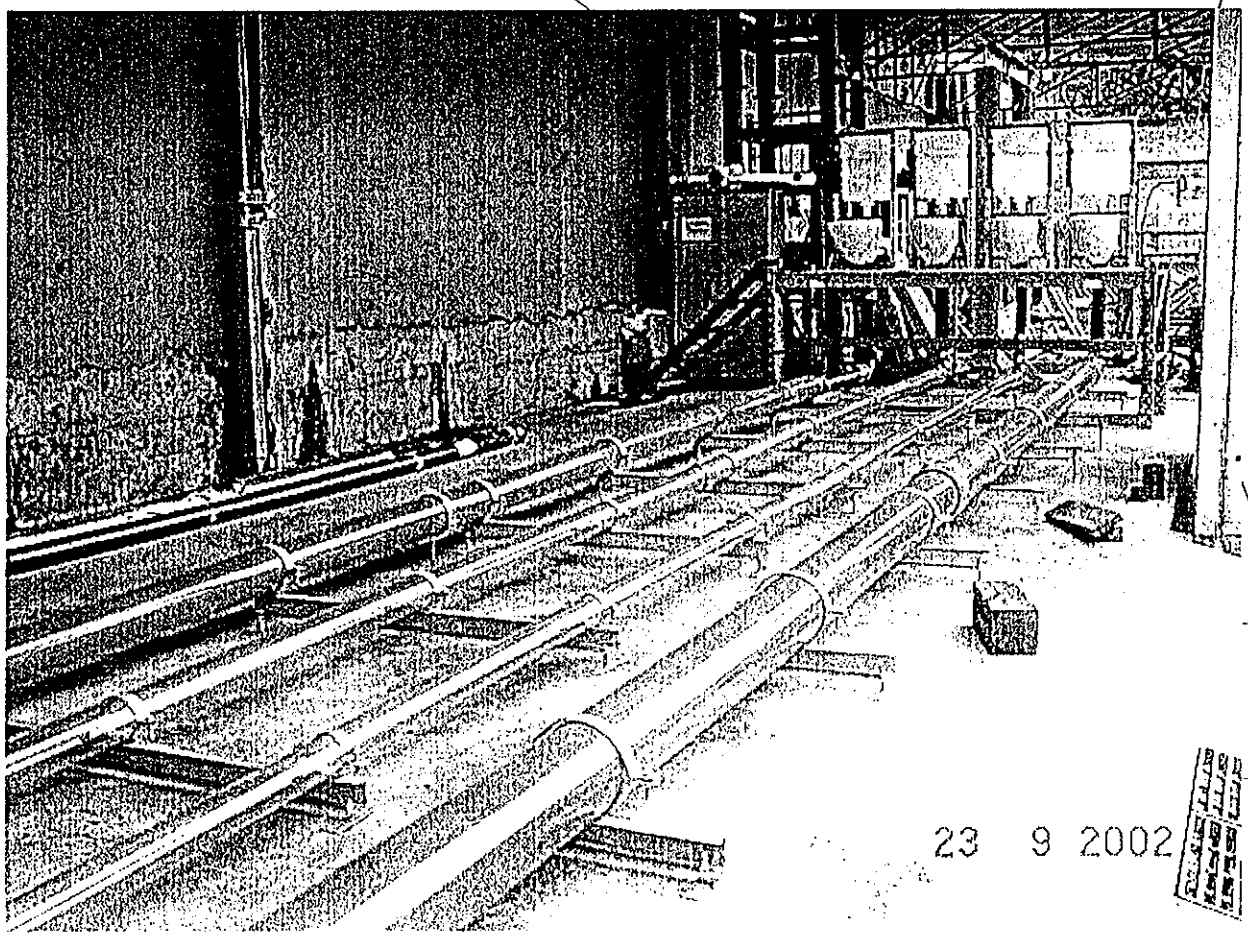
Setsco is an accredited laboratory in testing of various water fittings such as faucets, pipes, valves, compression fittings, water cisterns etc.

Singapore Plumbing Society had approached Setsco Services Pte Ltd to conduct an experiment on the use of lower volume of water for flushing the WC.

This is in-line with the long-term high rising demand of water usage in Singapore and the low availability of natural water supply.

The following study is to evaluate the effect of changing pipe sizes in the waste water piping system in order to deliver waste material efficiently with lower water consumption.

Test Procedure



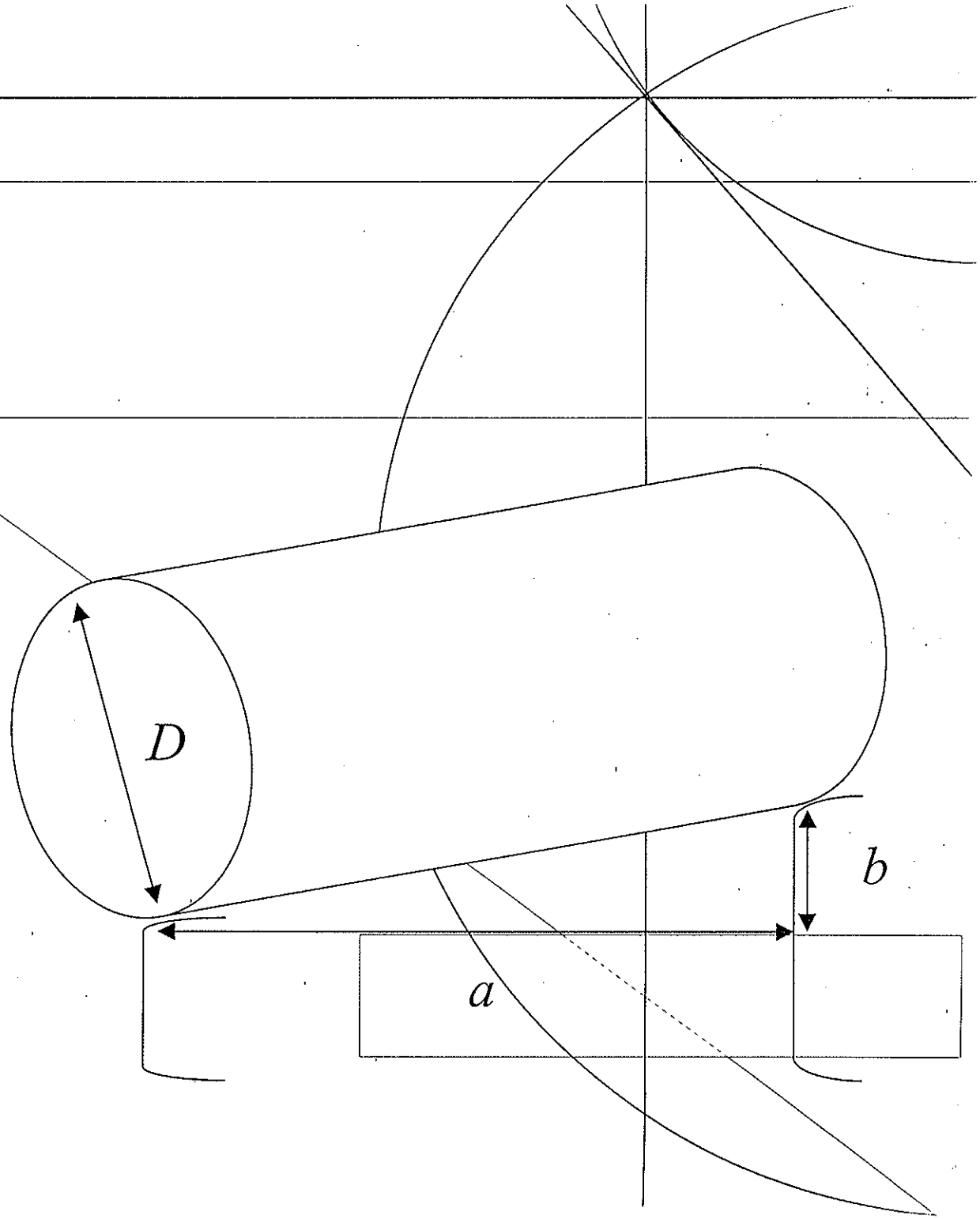
1. Test Setup with 10m Pipe Length Simulation

2. Three Pipes Varying in Diameter but Constant Gradient

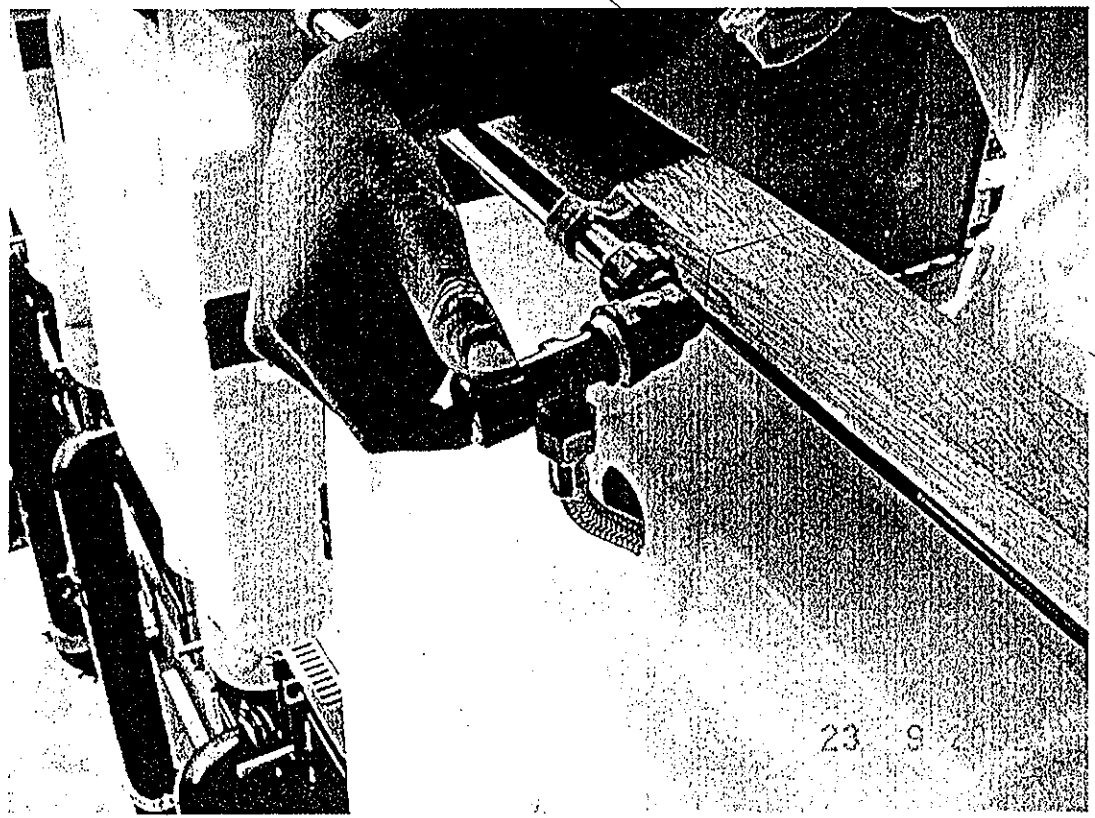
3. One Pipe Varies in Diameter and Gradient

4. Each Pipe attached to a 4.5 liter flushing capacity cistern

Test Procedure



Test Procedure

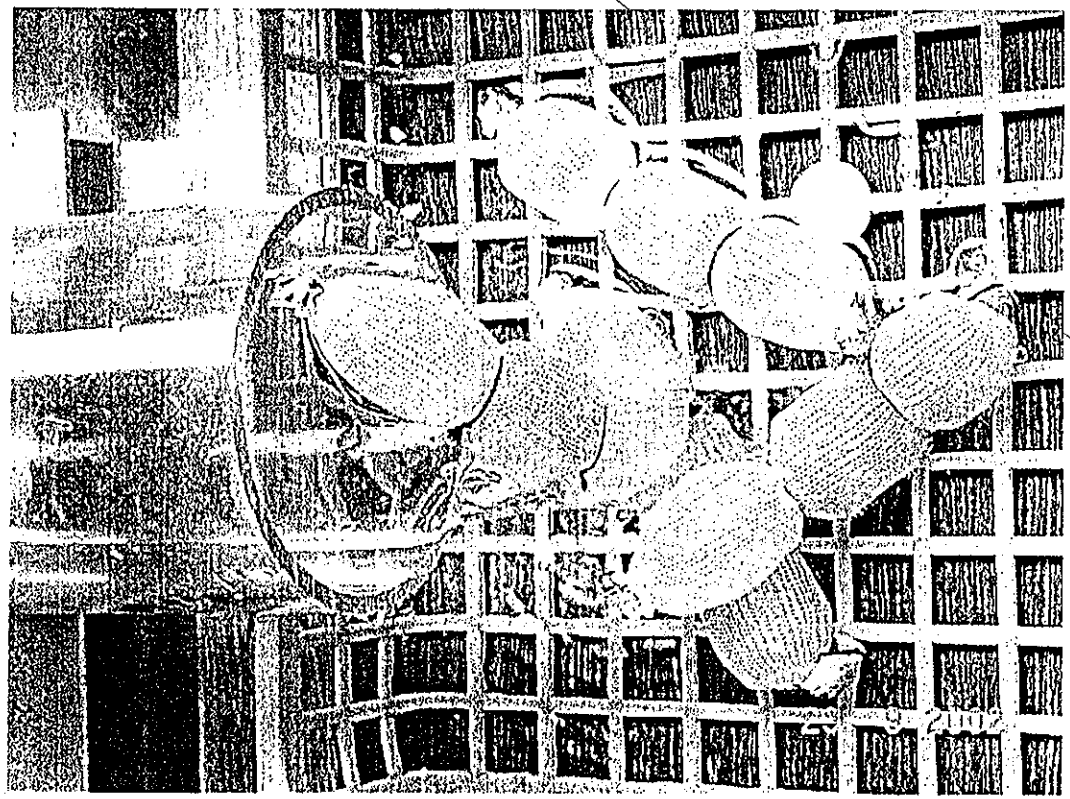


1. Water cisterns were set to provide 4.5 liters.

2. Water cisterns were verified and set by our laboratory staff.

3. This is to simulate the lower water consumption for flushing as compared to the normal usage in public toilets of 6 liters.

Test Procedure

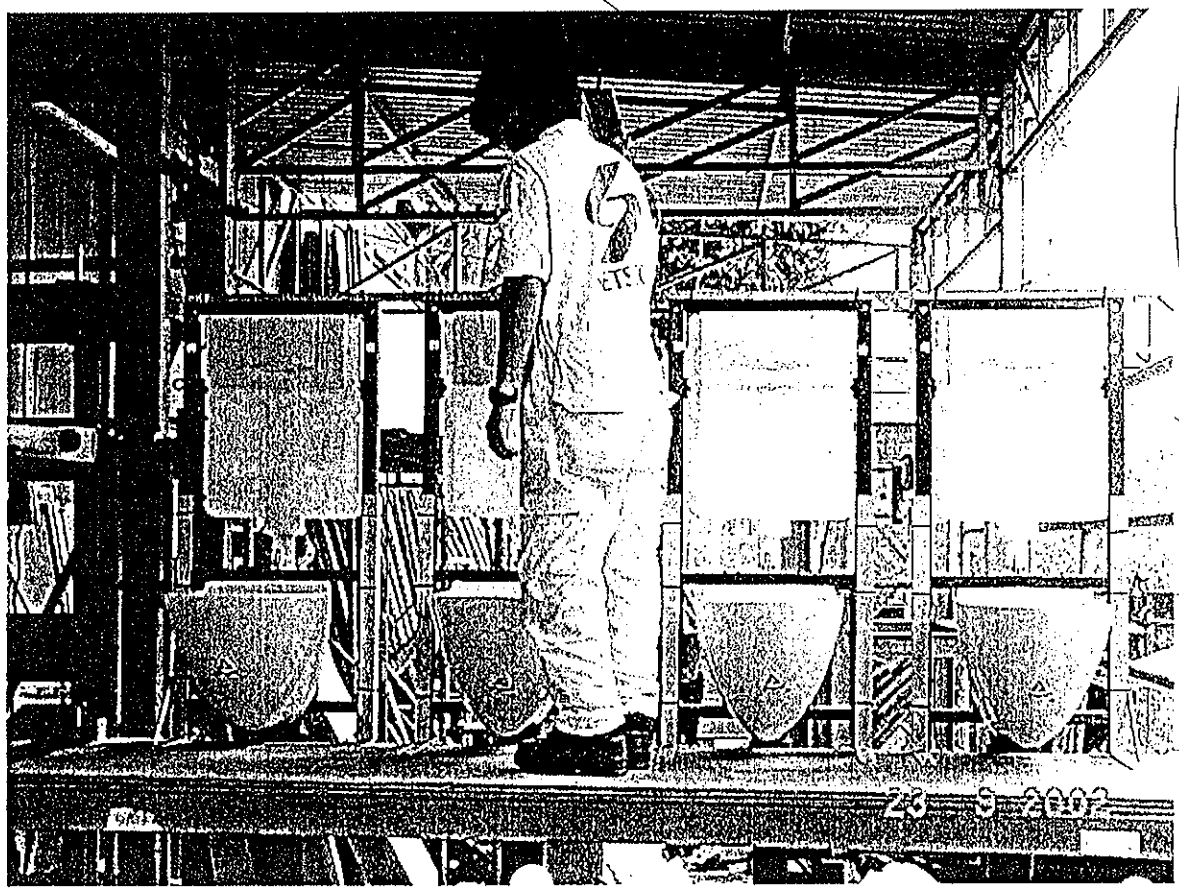


Test specimens used are said to be in compliance to Euronorm Specifications (EN)

The specimens are made of:

- 37ml water
- Artificial Skin
- String
- O-ring
- Metal Ring

Test Procedure



1. The test specimens were placed in each cistern and flushed

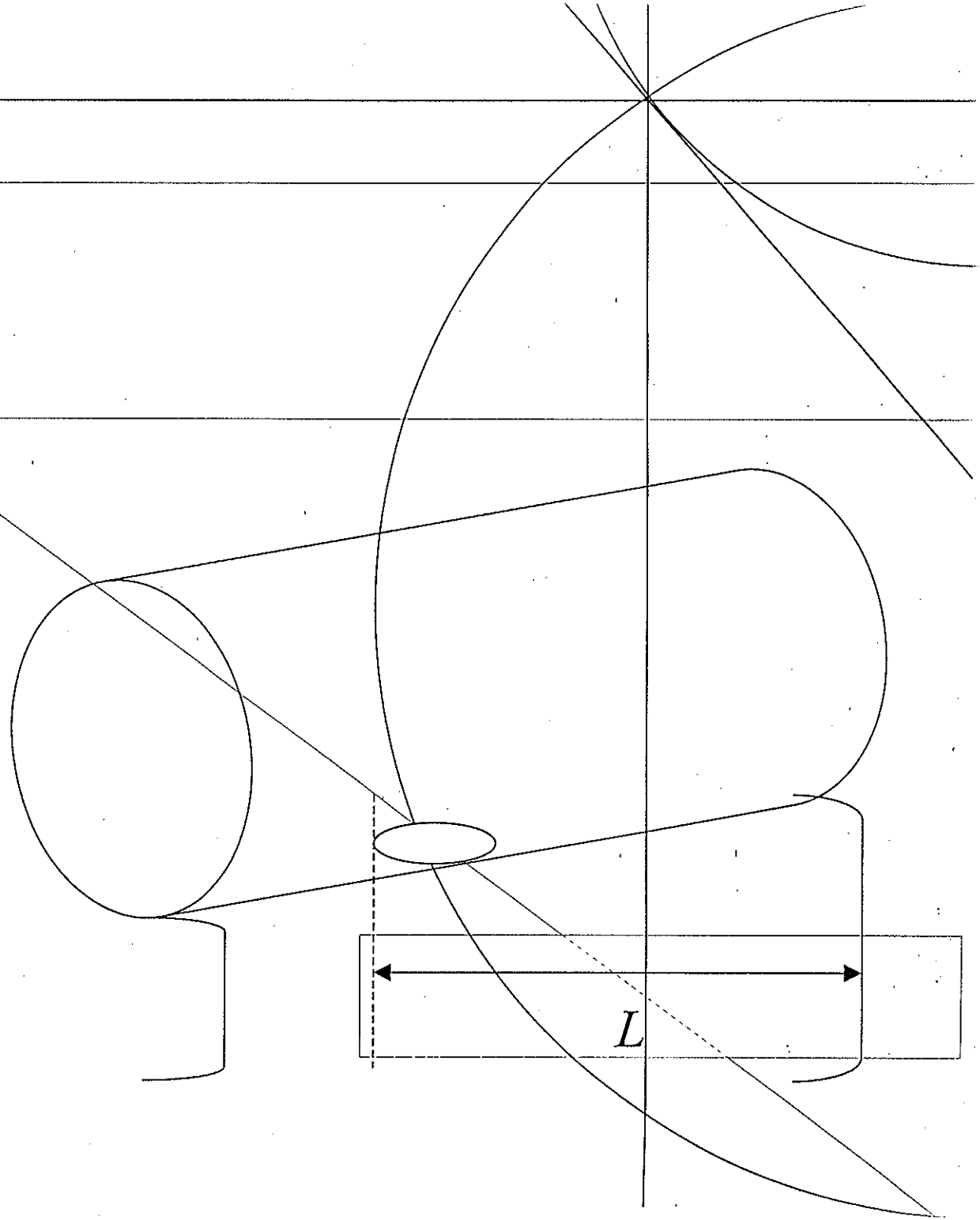
2. The distance traveled by the test specimens were then measured

Test Procedure

Measurement of the distance traveled by the test specimen is measured with the angle plate as the datum.

Each of the test specimen travel distance was measured.

This allows for other observation which will be discuss later.



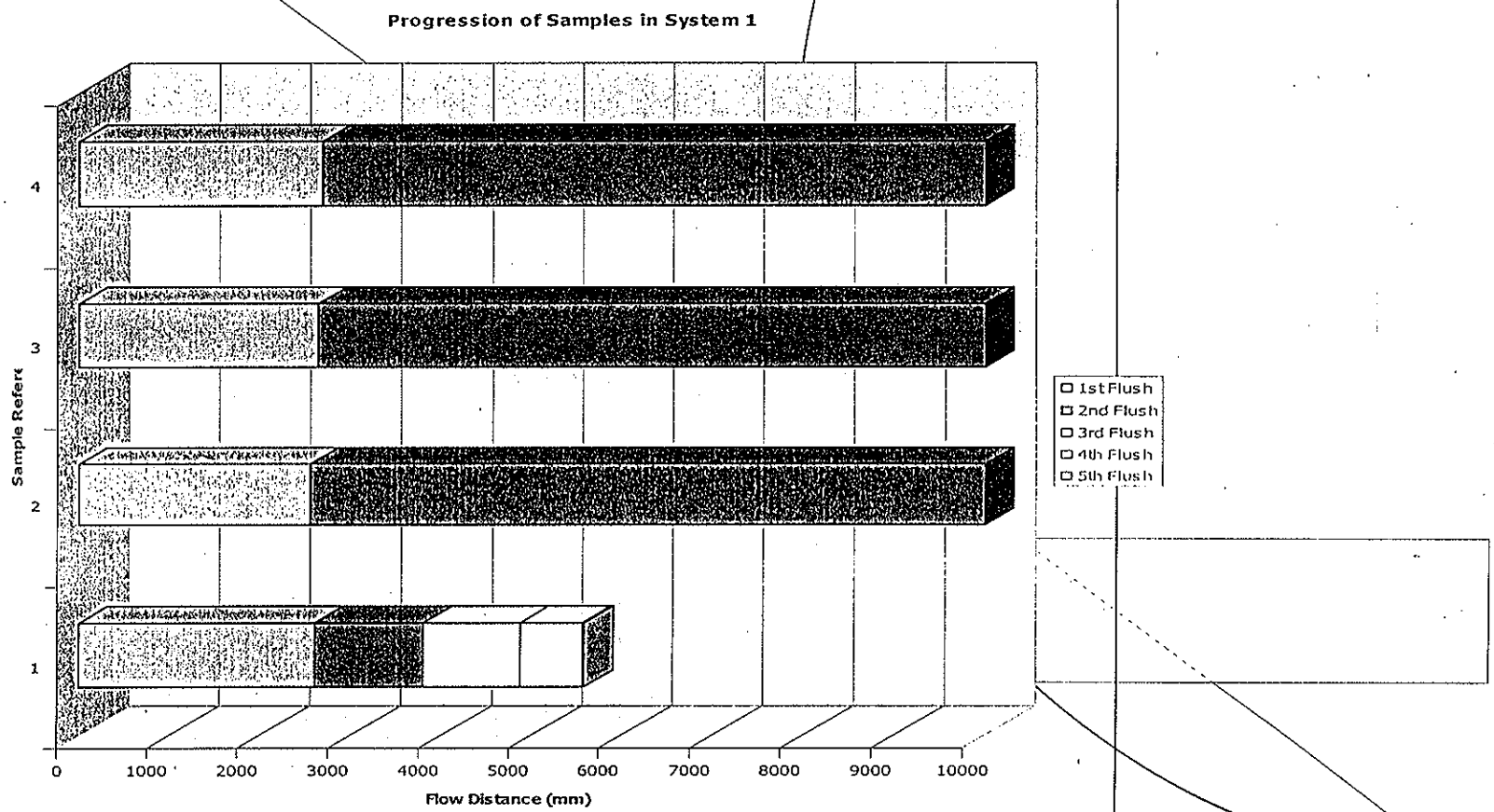
Results

System Reference	System 1	System 2	System 3	System 4
Pipe Size (inch)	6	4	3	8
Pipe Gradient	1:80	1:80	1:80	1:62.5
Total Water Discharge (l)	4.5	4.5	4.5	4.5

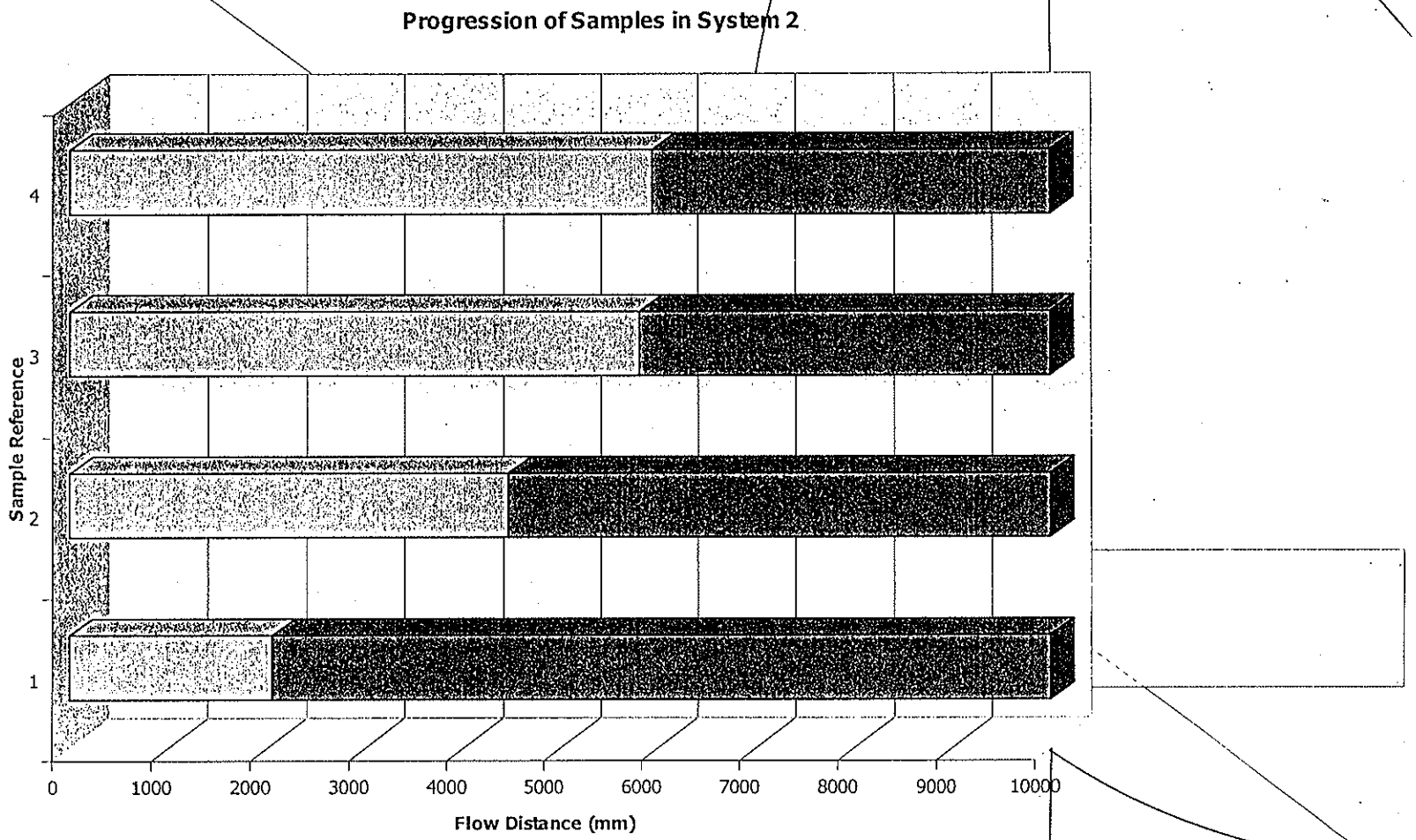
Results

System Reference	System 1				System 2				System 3				System 4			
Specimen Reference	TS1	TS2	TS3	TS4	TS1	TS2	TS3	TS4	TS1	TS2	TS3	TS4	TS1	TS2	TS3	TS4
1st Discharge Distance Travelled (m)	2600	2550	2640	2685	2050	4450	5795	5930	Clear				1490	1520	2716	3111
2nd Discharge Distance Travelled (m)	3800	Clear			Clear								2006	2596	2745	3450
3rd Discharge Distance Travelled (m)	4875												5189	4129	4587	5079
4th Discharge Distance Travelled (m)	5565												5488	4194	4709	5174
5th Discharge Distance Travelled (m)	5585												6104	5288	5486	5924

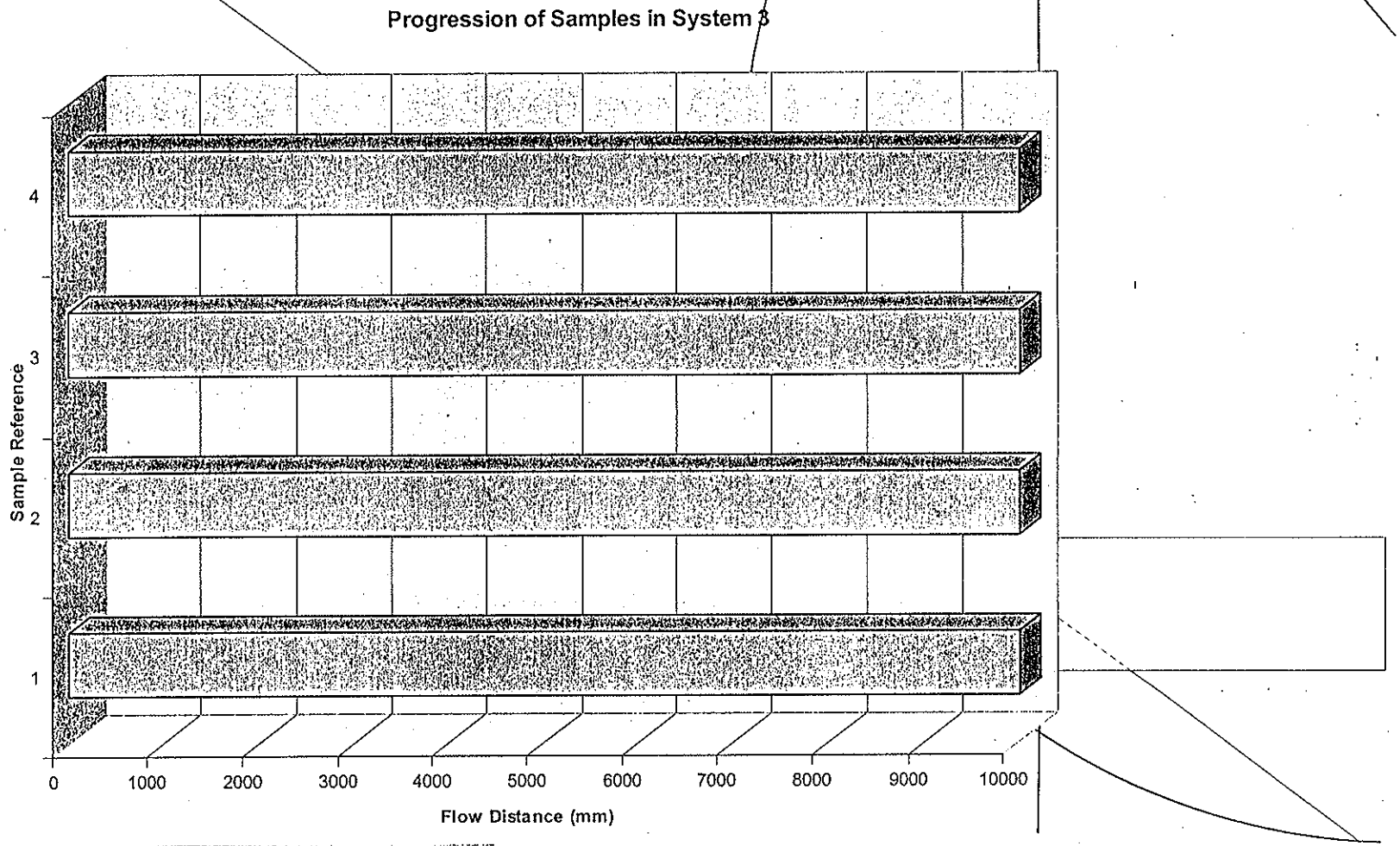
Results - System 1



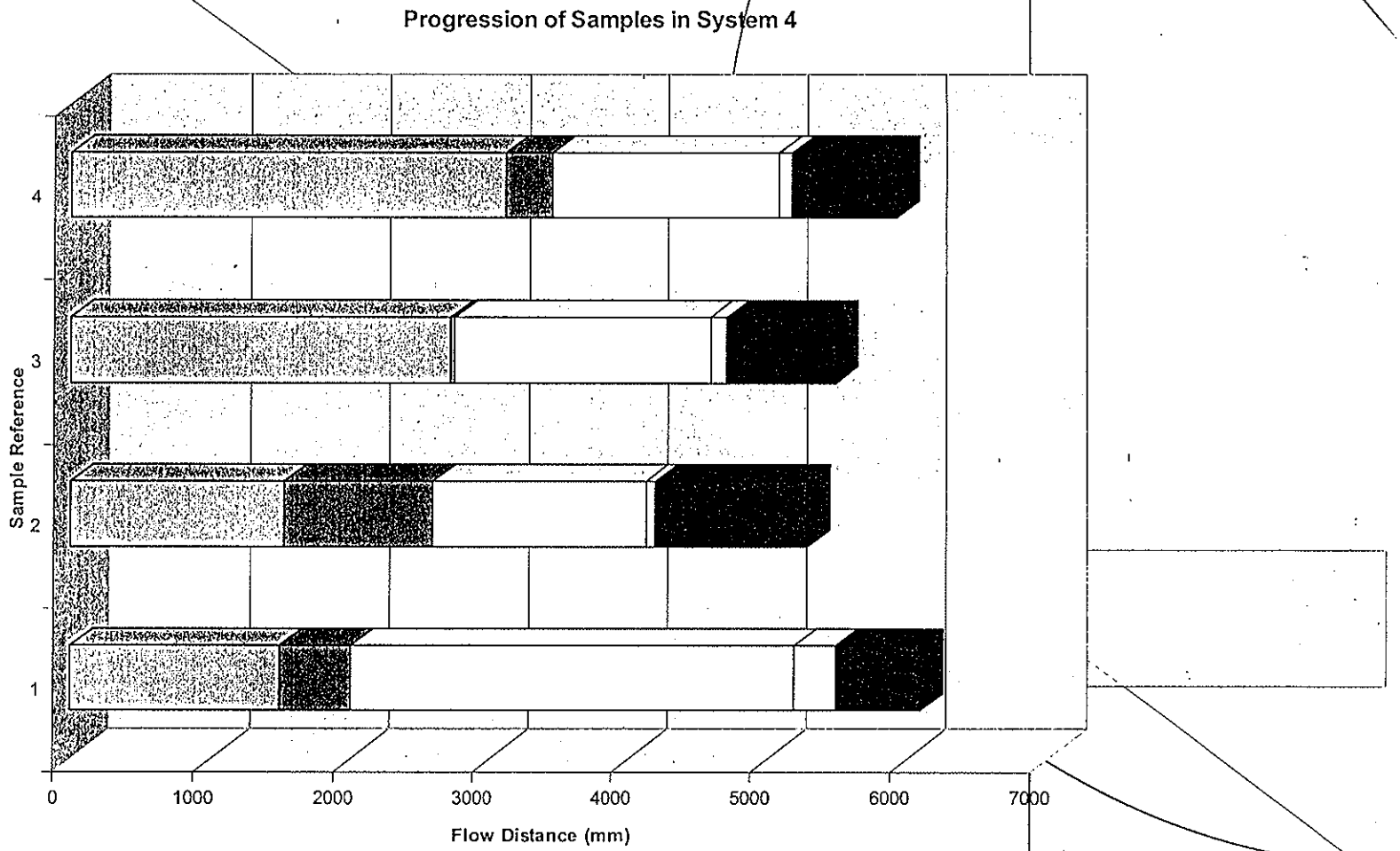
Results - System 2



Results - System 3



Results - System 4



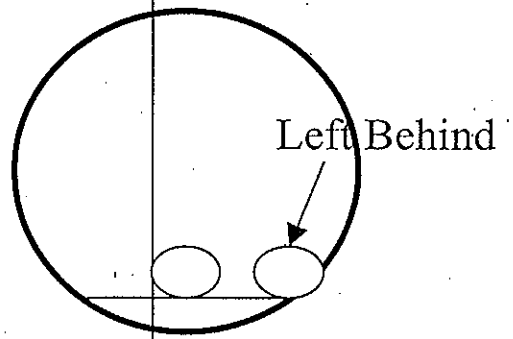
Observation

1. First system - Tendency to leave one test specimen behind.

2. Second system - Requires two flushes to clear

3. Third system - Requires one flush (although may require two flushes) to clear

4. Fourth system - Almost impossible to flush test specimens out even with five flushes



Conclusion

1, Given a flushing volume and a gradient, a smaller pipe size allows for more efficient flushing. On the contrary, larger pipe size may not provide sufficient water to transport the objects in the pipeline.

2. Pipe size is an important factor as it is demonstrated that a steeper gradient but a larger pipe size may not deliver an efficient system in flushing through a pipeline.