

References

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Table 1. Estimated Length, Internal Surface Area and Volume of Water Stored in Columbia, Missouri Water Distribution

Nominal Pipe Size Inches (i.d.)	Length of Mains, km	Internal Surface area, m ²	Storage Volume, m ³	Ratio of Surface Area to Volume m ² /m ³
<u>Distribution Mains</u>				
36 (36)	15.6	44,936	10,272	4.4
30 (30)	1.3	3,184	607	5.2
24 (24)	9.6	18,327	2,793	6.6
20 (20.760)	3.3	5,347	705	7.6
18 (18.68)	0.3	397	47	8.4
16 (16.60)	39.0	51,681	5,448	9.5
12 (12.46)	38.7	38,525	3,048	12.6
10 (10.40)	8.8	7,269	480	15.1
8 (8.39)	61.9	41,467	2,209	18.8
6 (6.28)	274.1	137,309	5,476	25.1
4 (4.22)	50.1	16,869	452	37.3
2.25 (2.25)	11.5	2,062	29	70.0
2	0.4	66	1	78.8
TOTALS (mains)	514.4	367,440	31,567	--
<u>Service Connections</u>				
6 (6.28)	0.2	117	4	25.1
4 (4.22)	1.0	331	8	37.3
2 (2)	5.6	898	11	78.8
1 (1)	24.5	1,956	12	157.5
0.75 (0.75)	628.8	37,633	179	210
TOTALS (Service)	660.1	40,934	216	--
<u>Plumbing</u>				
1 (1)	121	9,617	61	157.5
0.75 (0.75)	193	11,572	55	210
0.5 (0.5)	1,386	55,310	176	315
TOTALS (Plumbing)	1,700	76,499	292	--

Table 2. Bacterial Population and Chlorine Residuals at Consumer's Tap Versus in Distribution Mains

Storage Days	Household	Consumer's Tap (Initial Sample)			Distribution Main (Tap Flushed)		
		Total Bacteria, Cells/ml	HPC, CFU/ml	Chlorine, mg Cl/l	Total Bacteria Cells/ml	HPC, CFU/ml	Chlorine, mg Cl/l
<u>Columbia</u> (Groundwater)							
1	Eldred	6,410	321	0.5	45,300	6	0.8
1	Leawood	1,320	149	0.3	115	0	0.9
3	Eldred	47,100	4,170	0.1	1,270	2	1.3
3	Eldred	86,900	3,400	0.1	2,230	5	1.4
3	Johnson Ave.	75,900	24,000	0.0	1,910	89	1.6
3	Johnson Ave.	85,800	35,000	0.0	645	79	1.8
3	Riviera	56,400	4,410	0.0	7,780	32	0.6
7	Cedar Lane	1,840,000	130,000	0.0	17,100	824	0.8
7	Cunningham	1,840,000	102,000	0.0	2,350	1	0.7
7	Cunningham	2,590,000	393,000	0.0	3,270	45	0.9
7	Johnson Ave.	611,000	215,000	0.0	1,110	97	1.3
7	Riviera	71,700	4,370	0.0	3,950	5	0.1
<u>Jefferson City</u> (Surface Water)							
1	Hayzelton	440,000	82,100	0.0	47,000	303	1.4
1	Hayzelton	513,000	162,000	0.0	65,000	543	1.2
1	Hayzelton	333,000	56,800	0.1	297,000	80	1.3
3	Hayzelton	1,680,000	67,000	0.1	110,000	290	1.1
3	Hayzelton	947,000	189,000	0.0	23,900	513	0.8
3	Hayzelton	508,000	112,000	0.0	123,000	373	1.4
3	Hayzelton	858,000	201,000	0.0	158,000	363	1.4
3	Hayzelton	2,190,000	934,000	0.0	264,000	923	0.4
7	Hayzelton	1,520,000	41,000	0.0	43,600	293	0.7

Table 3a. Results of Controlled Experiments to Distinguish between Regrowth and Aftergrowth
(Tucker Hall, University of Missouri-Columbia)

Ratio of HPC to Total Bacteria and Chlorine Residual

$\frac{\text{HPC, CFU/ml}}{\text{Total Bacteria, cells/ml}}$ (%); Chlorine, mg Cl/l

Period of Storage, Days	<u>0</u>	<u>3</u>	<u>7</u>	<u>14</u>	<u>21</u>
Chlorinated Water, Stored in Clean Glass	$\frac{52(0.4);0.55}{14700}$	$\frac{29(0.1);0.35}{33200}$	$\frac{233(1.9);0.30}{12000}$	$\frac{326(1.8);0.03}{18000}$	$\frac{129(0.1);trace}{99300}$
Δ Total Bacteria = Control	0	18500	(2700)	3300	84600
Dechlorinated Water*, Stored in Clean Glass	$\frac{52(0.4);0.55}{14700}$	$\frac{567(1.4);0.0}{41500}$	$\frac{41300(11.3);0.0}{268000}$	$\frac{25300(11.3);0.0}{223000}$	$\frac{20800(7.8);0.0}{266000}$
Δ Total Bacteria = Regrowth	0	26800	253300	208300	251300
Water Stored in Distribution Piping	$\frac{52(0.4);0.55}{14700}$	$\frac{52(0.07);0.0}{72500}$	$\frac{83700(33.3);0.0}{251000}$	$\frac{137000(28.0);0.0}{489000}$	$\frac{103000(16.6);0.0}{621000}$
Δ Total Bacteria = Regrowth + Aftergrowth	0	57800	236300	474300	606300

* Water dechlorinated with sodium thiosulfate prior to placement in clean glass tubes.

Table 3b. Results of Controlled Experiments to Distinguish between Regrowth and Aftergrowth
(Engineering Building, University of Missouri-Columbia)

Ratio of HPC to Total Bacteria and Chlorine Residual

HPC, CFU/ml (%); Chlorine, mg Cl/l
Total Bacteria, cells/ml

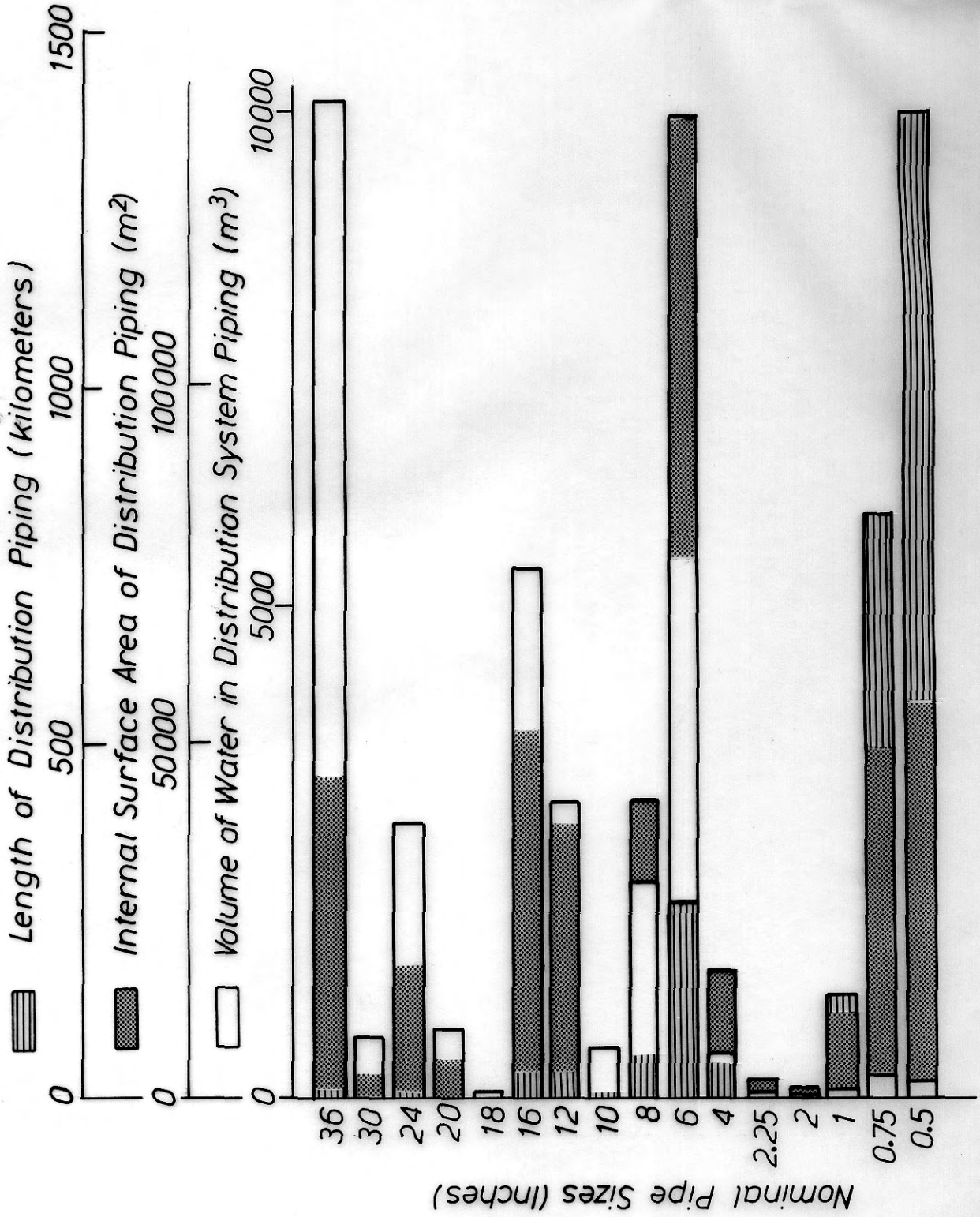
Period of Storage, Days	<u>0</u>	<u>3</u>	<u>7</u>	<u>14</u>	<u>21</u>
Chlorinated Water, Stored in Clean Glass	<u>3(0.0);0.45</u> 14700	<u>0(0.0);0.22</u> 41700	<u>0(0.0);0.2</u> 14900	<u>0(0.0);0.1</u> 333000	<u>3(0.0);0.02</u> 121000
Δ Total Bacteria = Control	0	27000	0	318300	106300
Dechlorinated Water, Stored in Clean Glass	<u>3(0.0);0.45</u> 14700	<u>467(0.9);0.0</u> 49700	<u>238000(65.4);0.0</u> 364000	<u>166000(68.0);0.0</u> 244000	<u>103000(31.2);0.0</u> 330000
Δ Total Bacteria = Regrowth	0	35000	349300	229300	315300
Water Stored in Distribution Piping	<u>3(0.0);0.45</u> 14700	<u>367(0.5);0.0</u> 81400	<u>53700(25.3);0.0</u> 212000	<u>64700(22.0);0.0</u> 294000	<u>50000(15.6);0.0</u> 320000
Δ Total Bacteria = Regrowth + Aftergrowth	0	66700	197300	279300	305300

Table 3c. Results of Controlled Experiments to Distinguish between Regrowth and Aftergrowth
(LeFevre Hall, University of Missouri-Columbia)

Ratio of HPC to Total Bacteria and Chlorine Residual

HPC, CFU/ml _____ (%); Chlorine, mg *Cl*/*l*
Total Bacteria, cells/ml

Period of Storage, Days	<u>0</u>	<u>3</u>	<u>7</u>	<u>14</u>	<u>21</u>
Chlorinated Water, Stored in Clean Glass	<u>32(0.3);0.53</u> 11800	<u>17(0.1);0.35</u> 27000	<u>18(0.2);0.2</u> 9170	<u>79(0.9);0.18</u> 8770	<u>8(0.0);0.05</u> 31400
Δ Total Bacteria = Control	0	15200	(2360)	(3030)	19600
Dechlorinated Water, Stored in Clean Glass	<u>32(0.3);0.53</u> 11800	<u>21000(22.3);0.0</u> 94300	<u>62000(30.1);0.0</u> 206000	<u>82300(24.0);0.0</u> 343000	<u>131000(30.5);0.0</u> 429000
Δ Total Bacteria = Regrowth	0	82500	194200	331200	417200
Water Stored in Distribution Piping	<u>32(0.3);0.53</u> 11800	<u>12500(10.2);0.0</u> 123000	<u>27800(21.6);0.0</u> 129000	<u>46300(12.4);0.0</u> 372000	<u>60700(12.5);0.0</u> 485000
Δ Total Bacteria = Regrowth + Aftergrowth	0	111200	117200	260200	473200

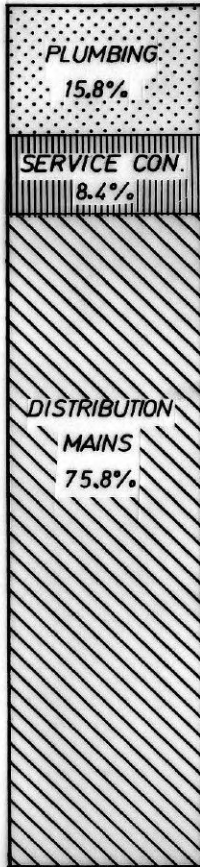
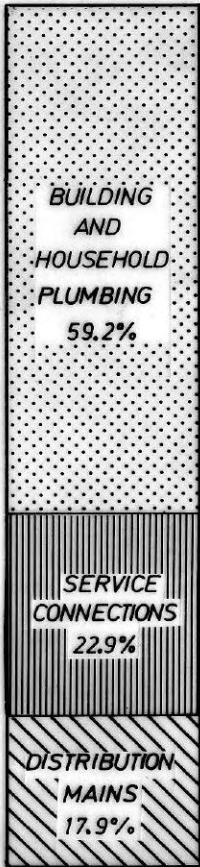


TOTAL PIPE:-

Length
= 2872 km

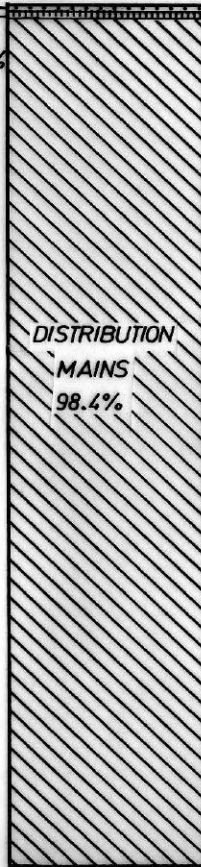
Surface Area
= 484,872 m²

Volume
= 32,074 m³



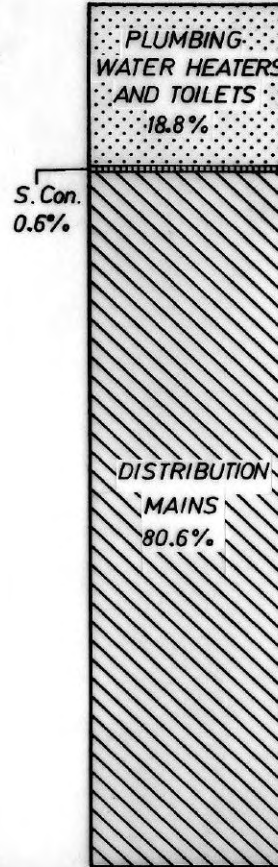
0.9% Plumb.

0.7% S.C.



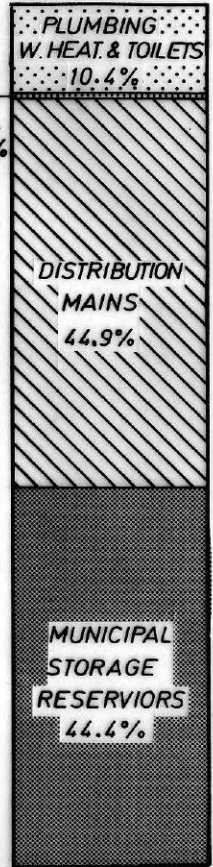
Distribution System Volume
Exclusive of Municipal Storage Reservoirs
= 39,144 m³

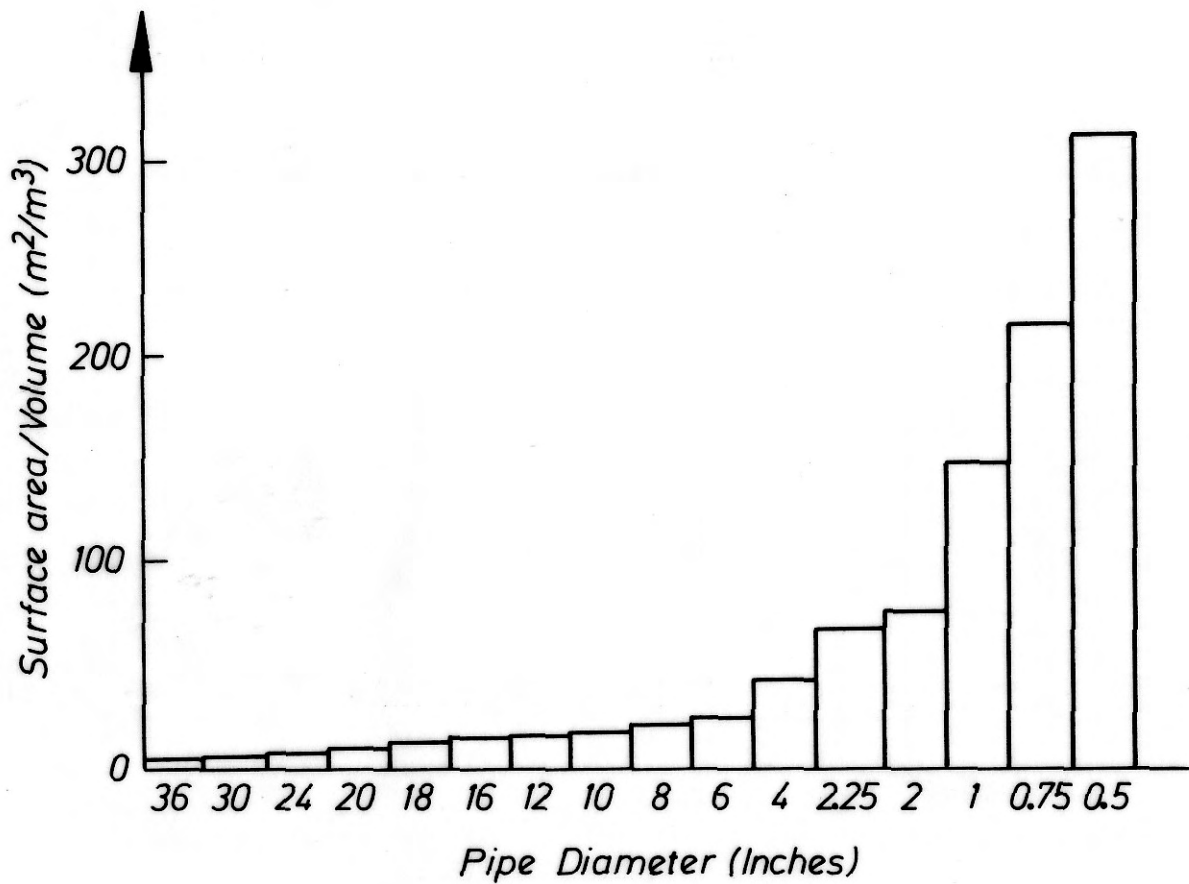
Total Distribution System Volume
= 70,374 m³

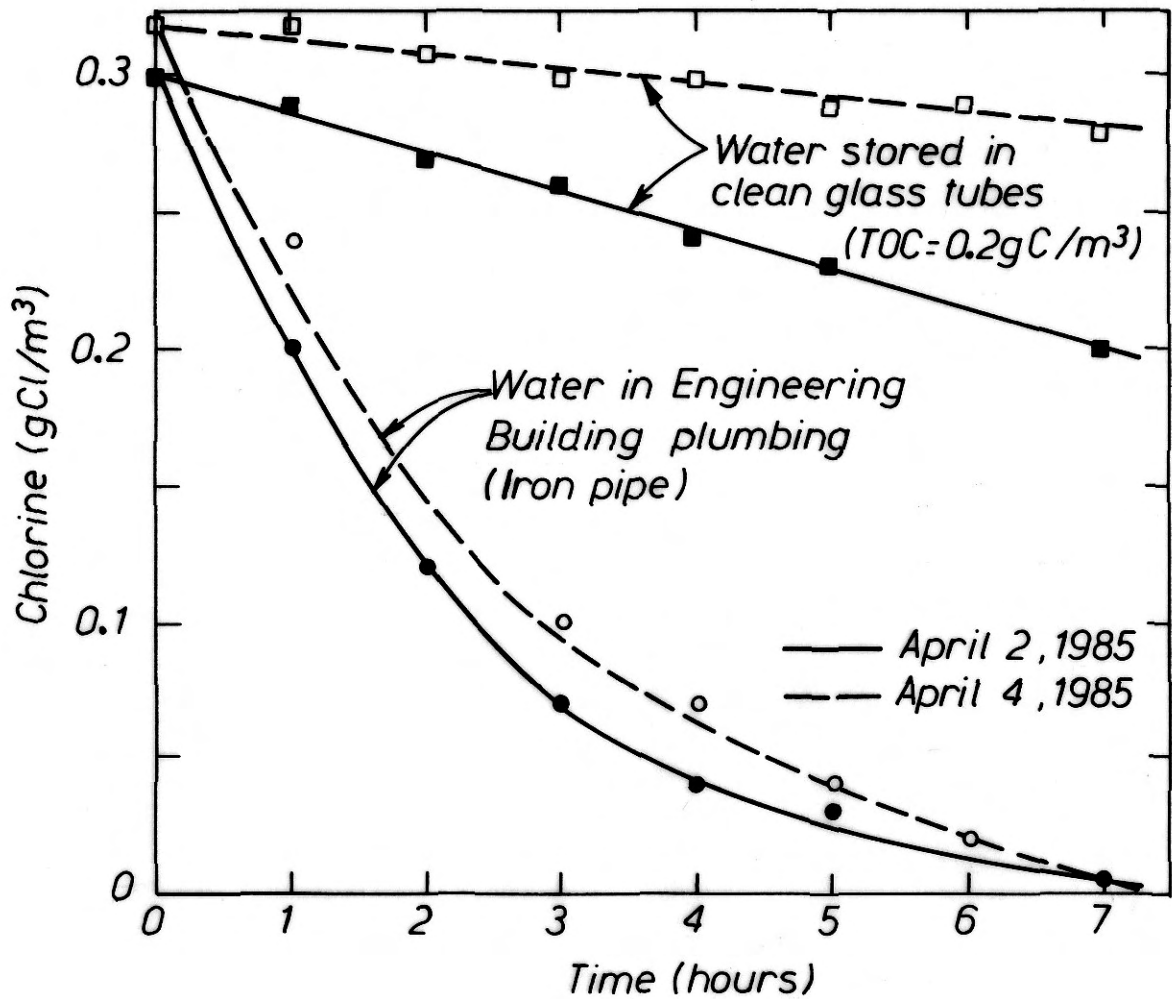


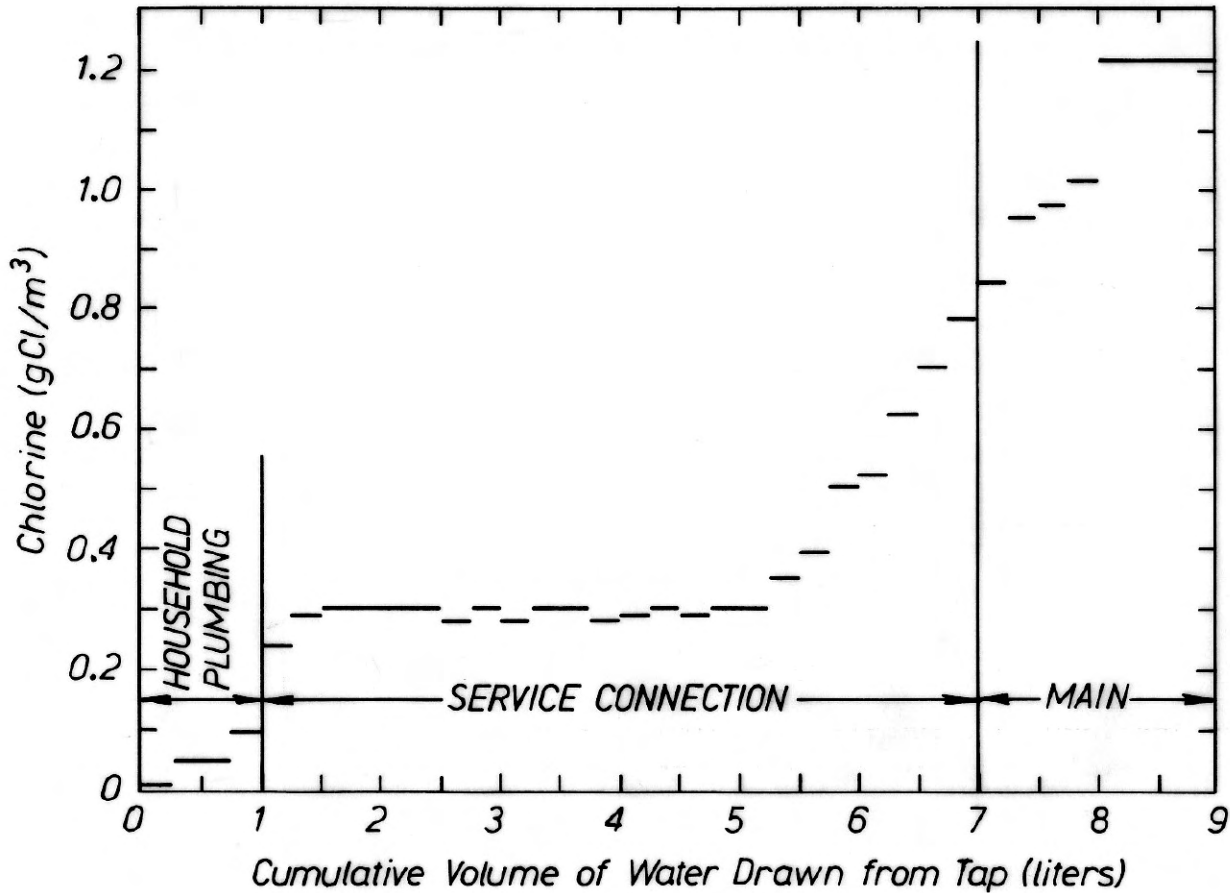
S. Con. 0.6%

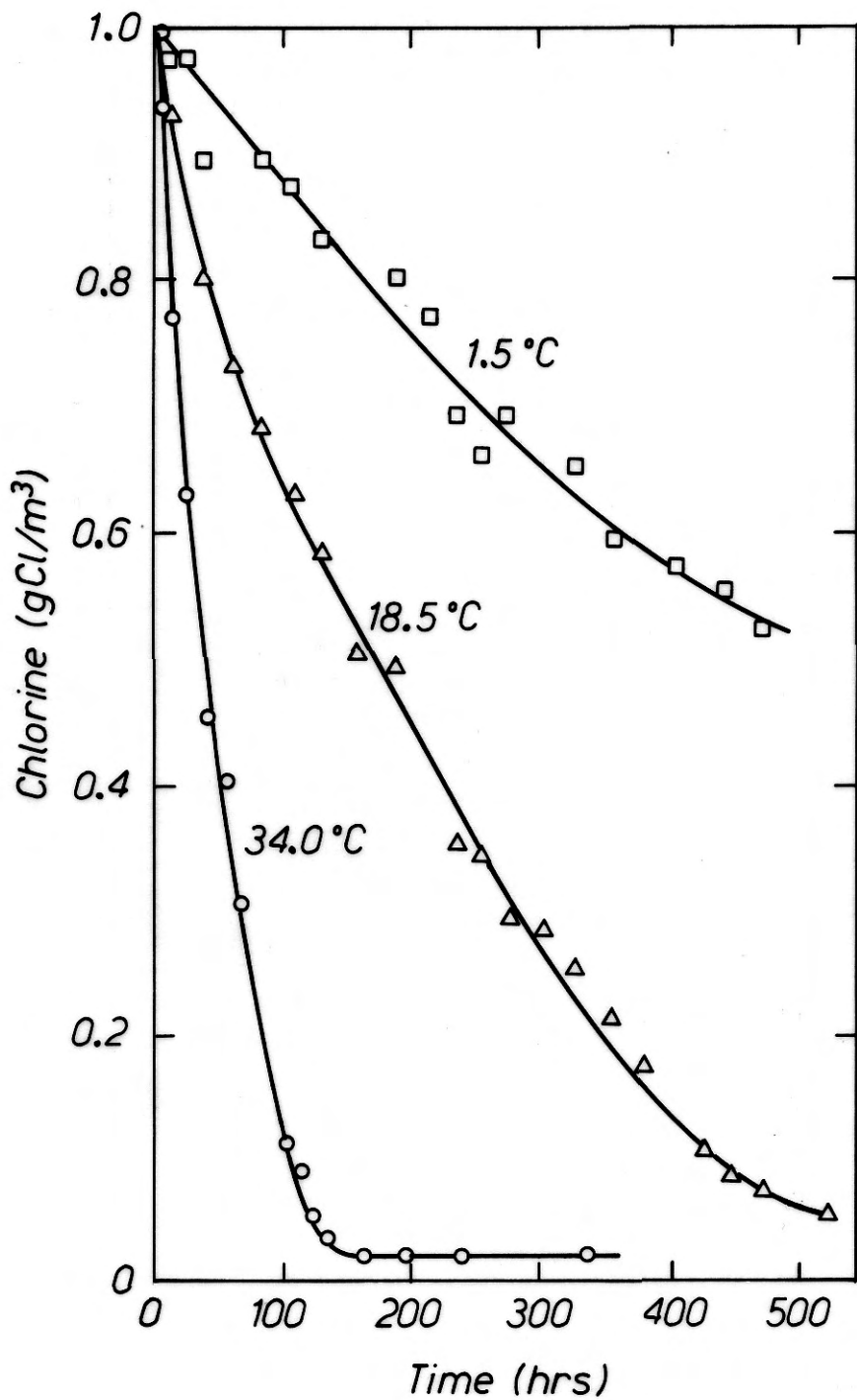
S.C. 0.3%

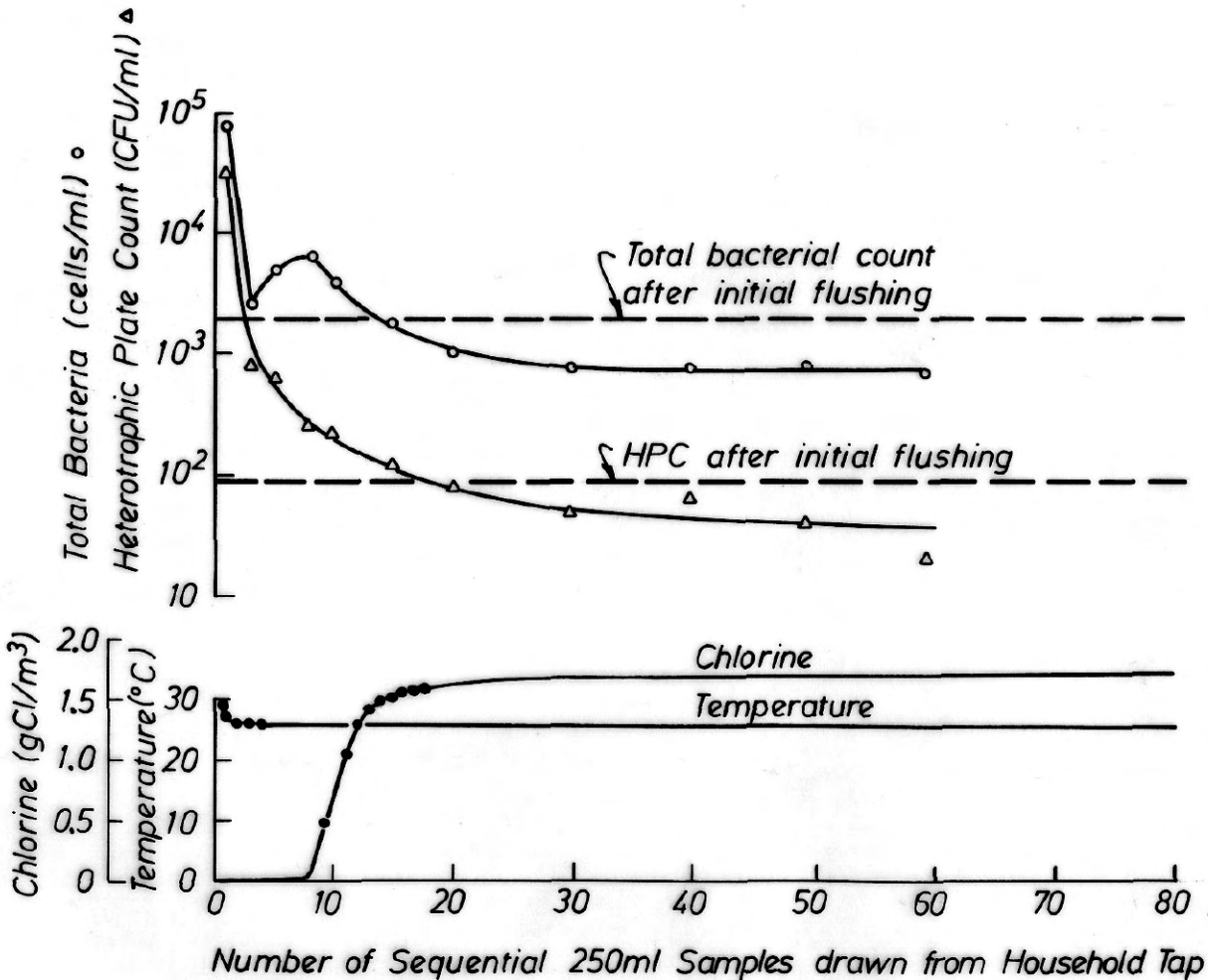


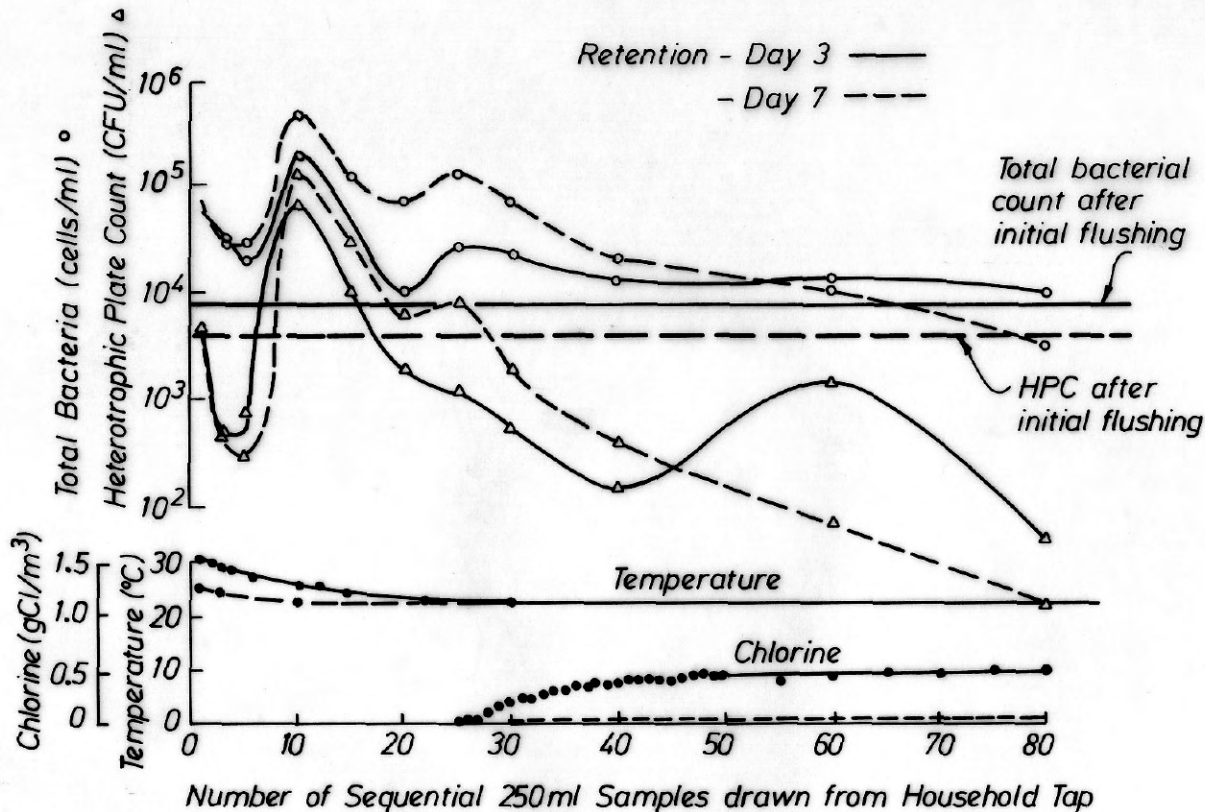


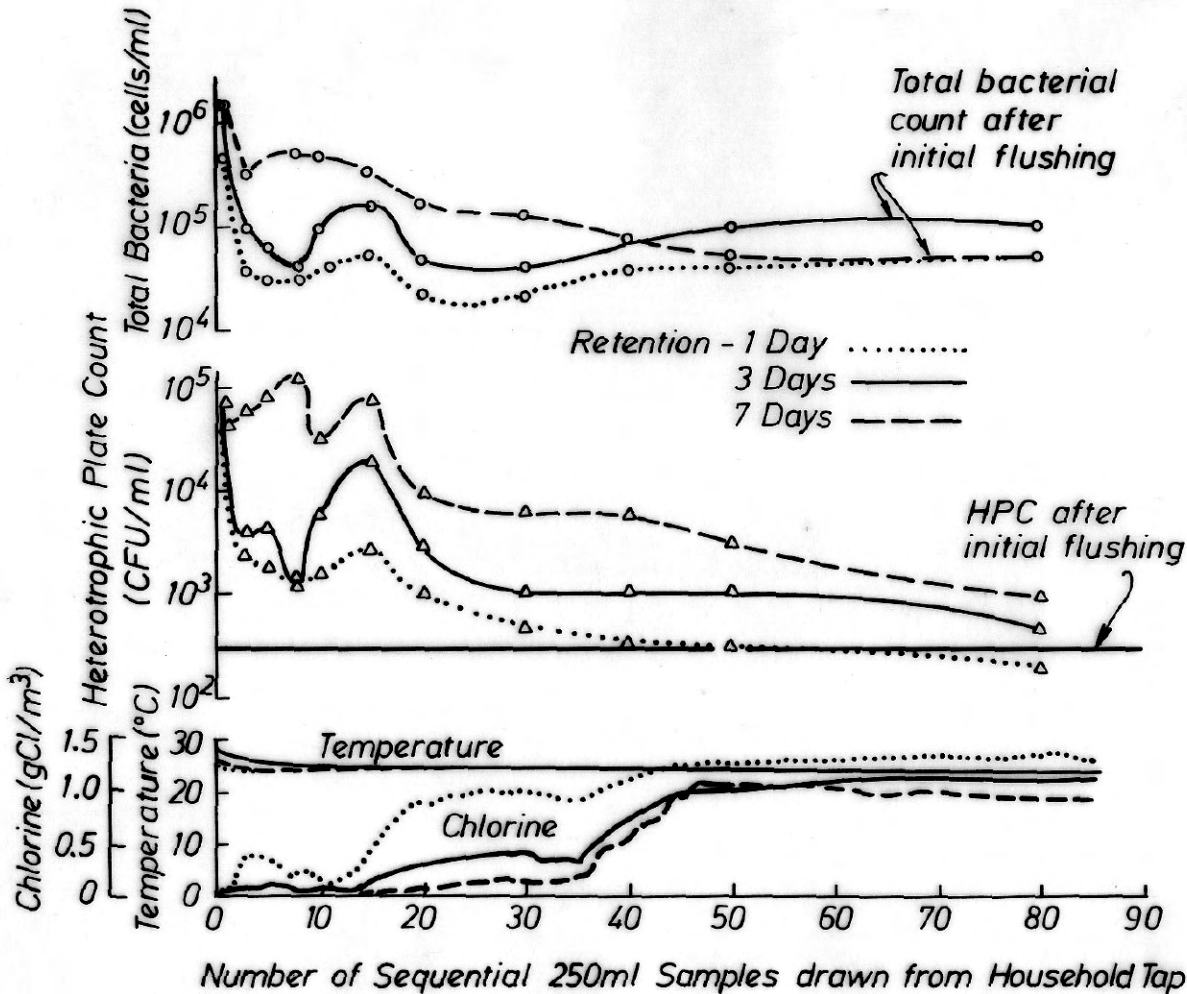


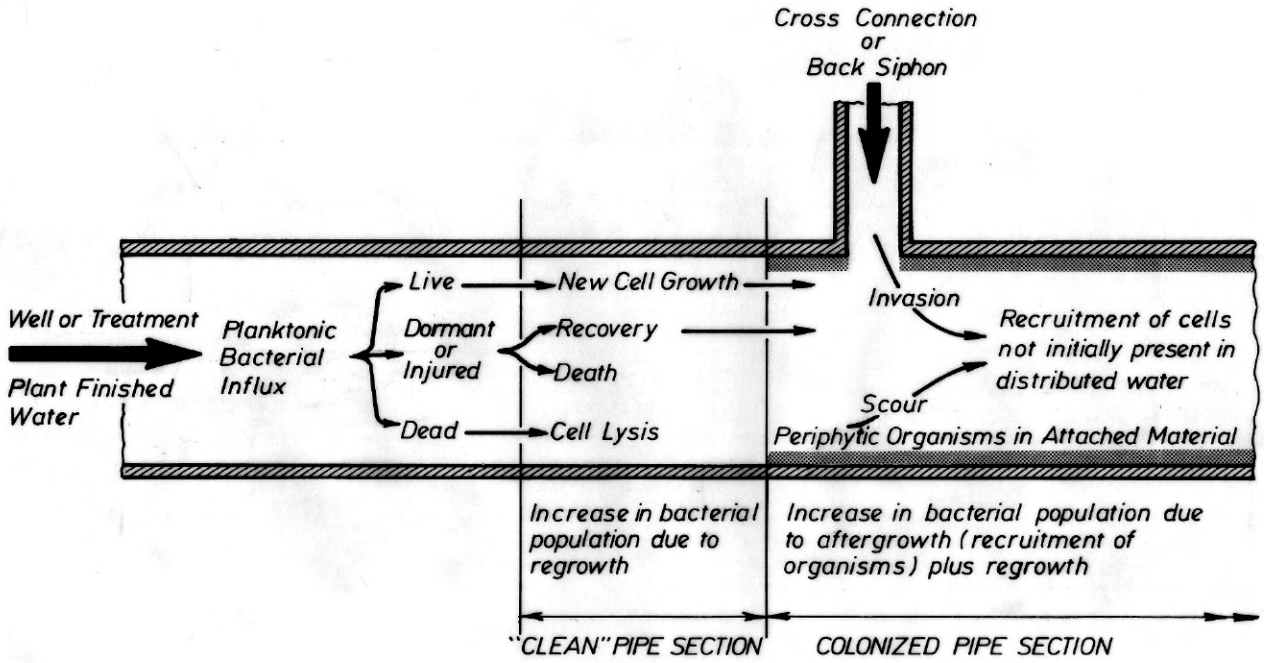


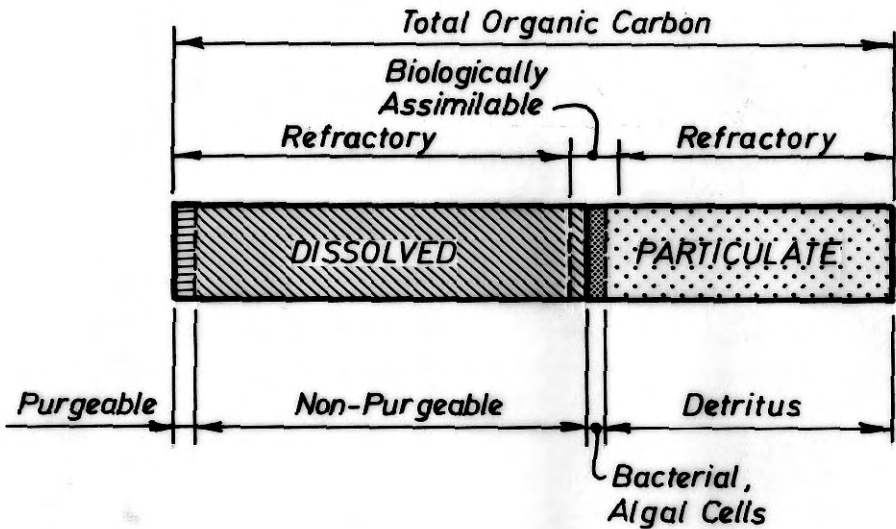












PARTITIONING OF TOTAL ORGANIC CARBON