

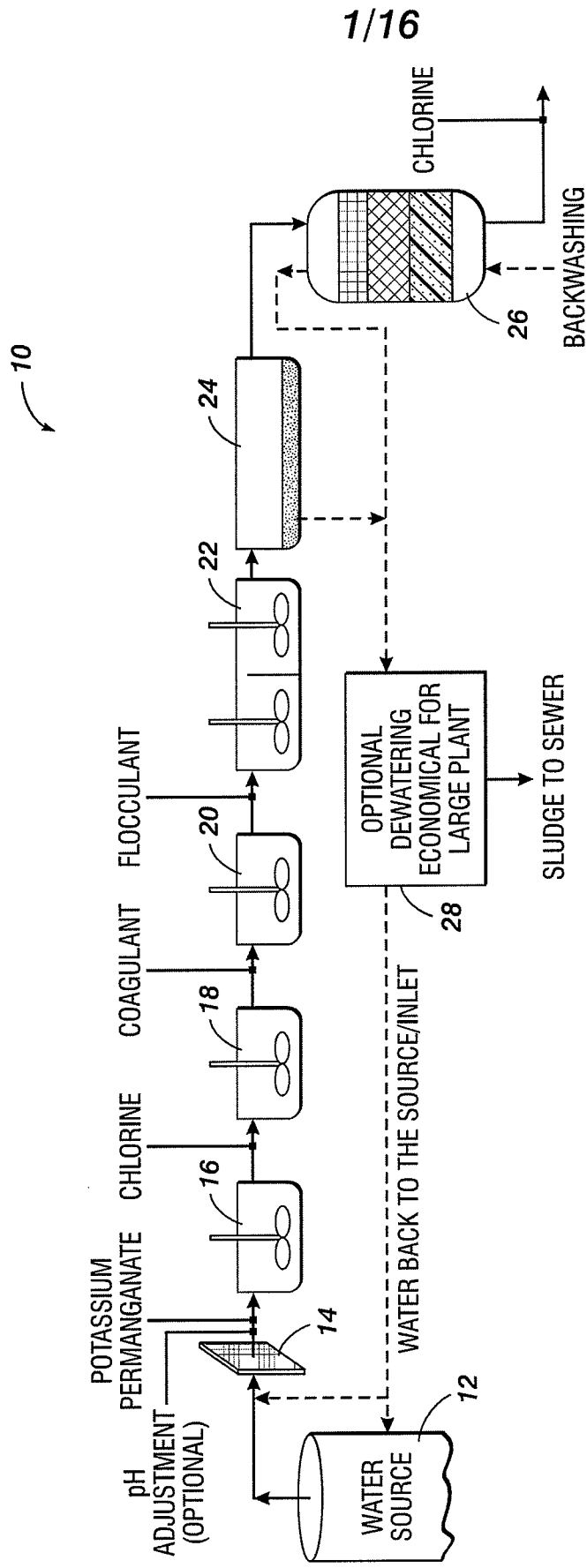


FIG. 1

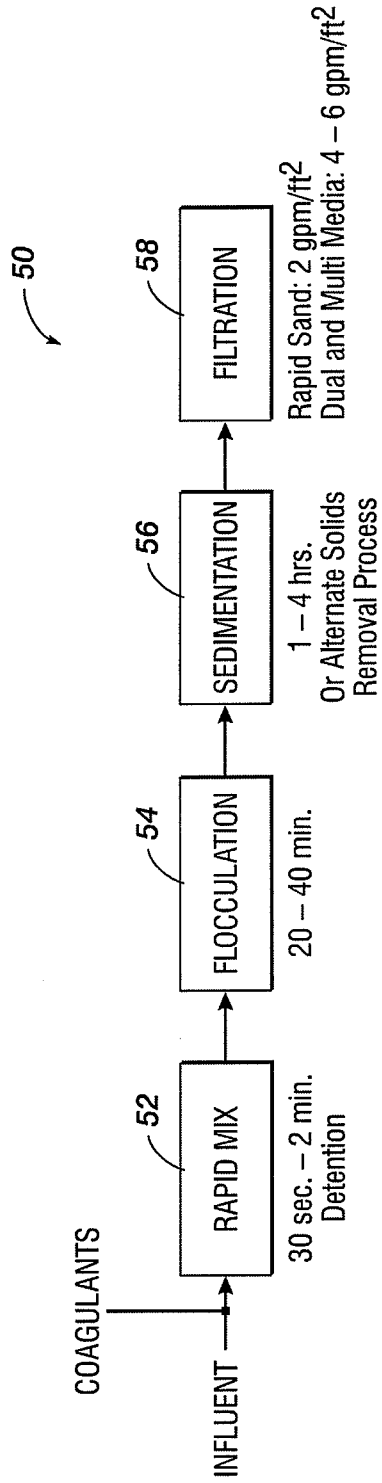


FIG. 2

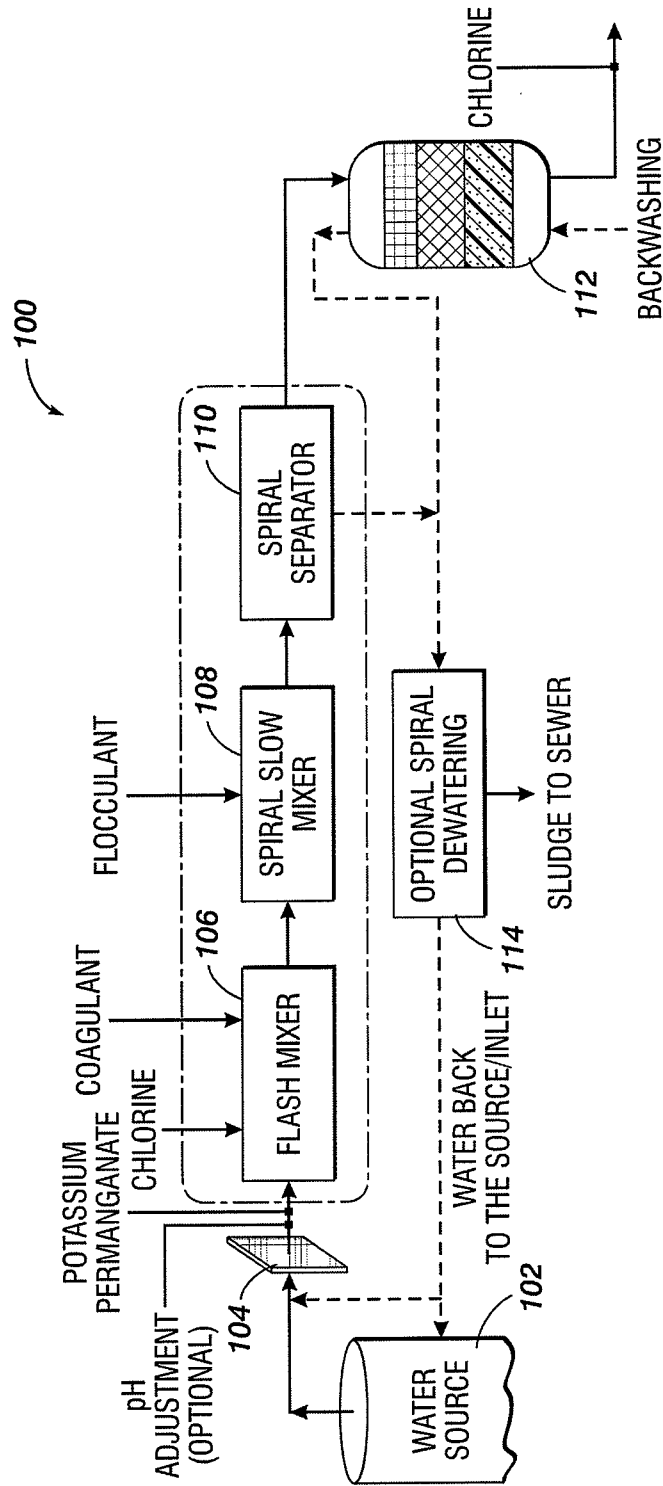


FIG. 3(a)

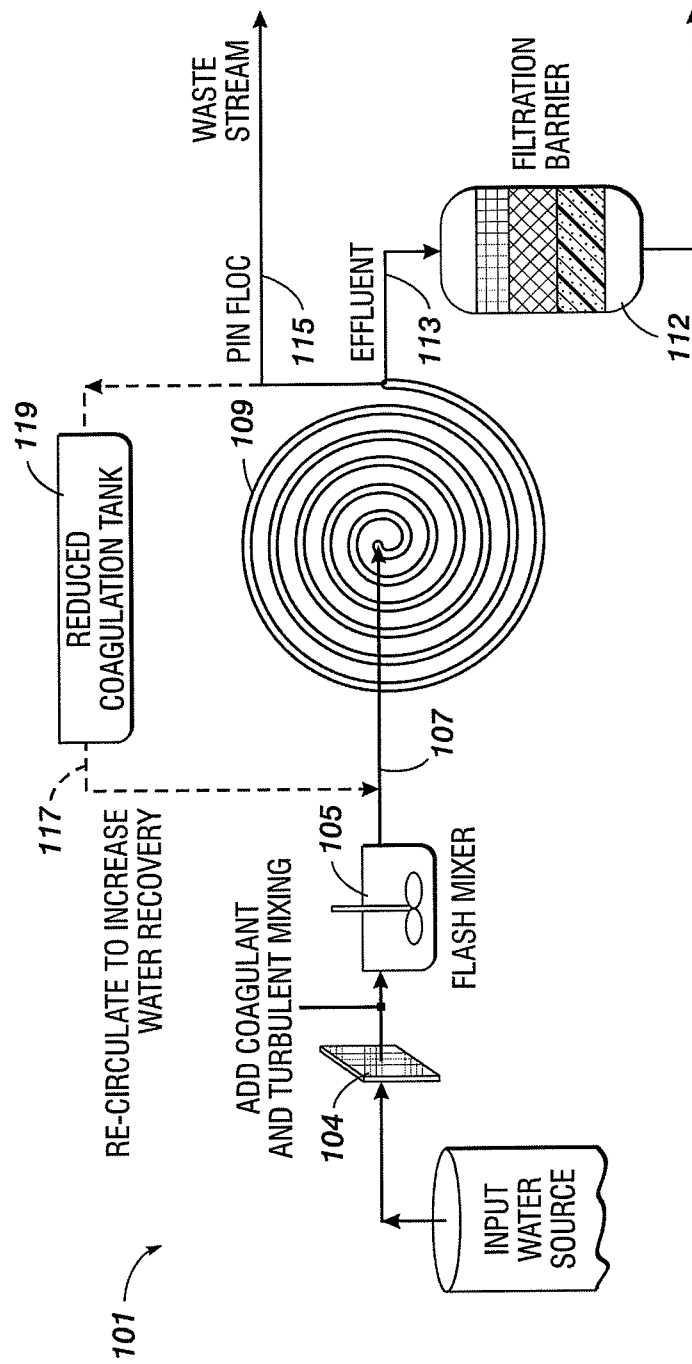


FIG. 3(b)

FIG. 4(a)

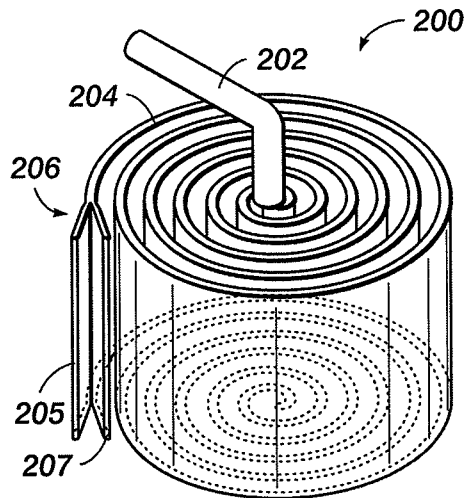


FIG. 4(b)

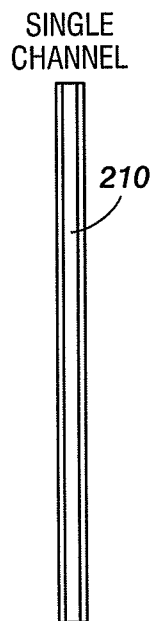
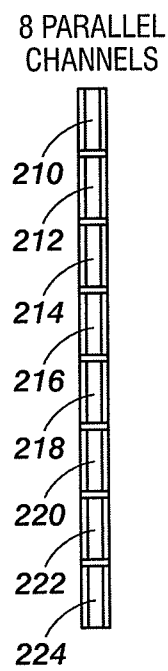


FIG. 4(c)



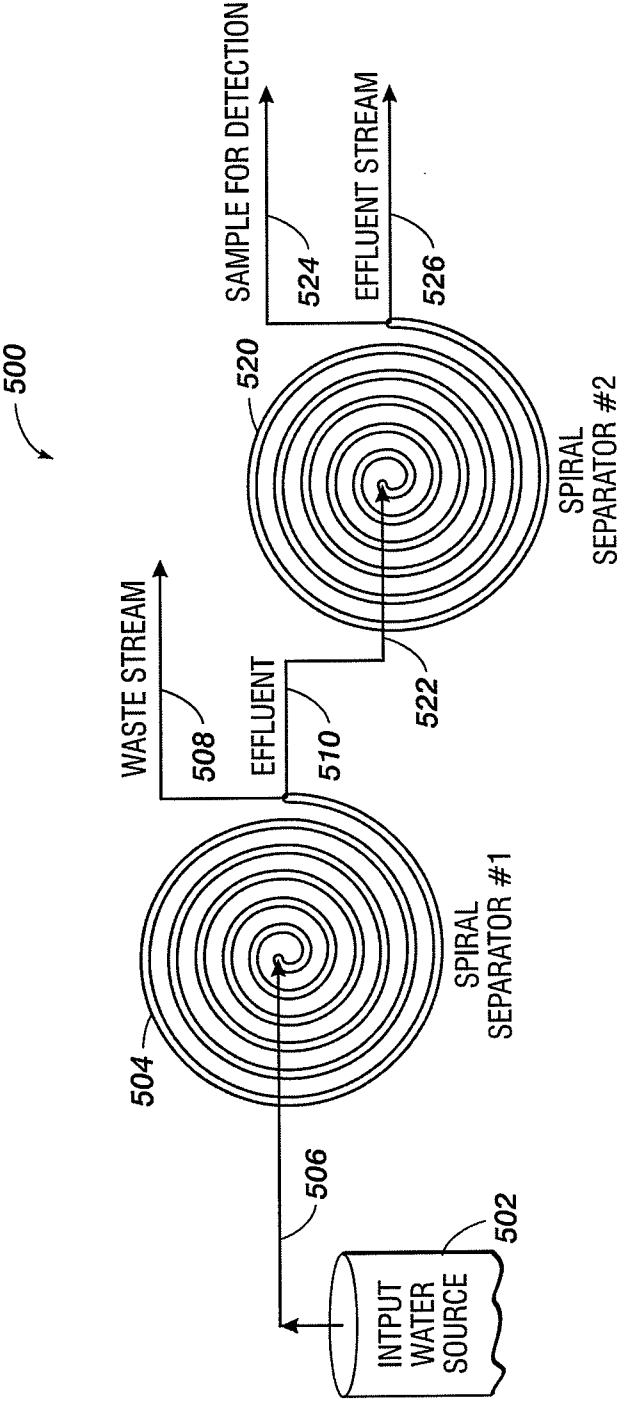


FIG. 5

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FIG. 6(a)

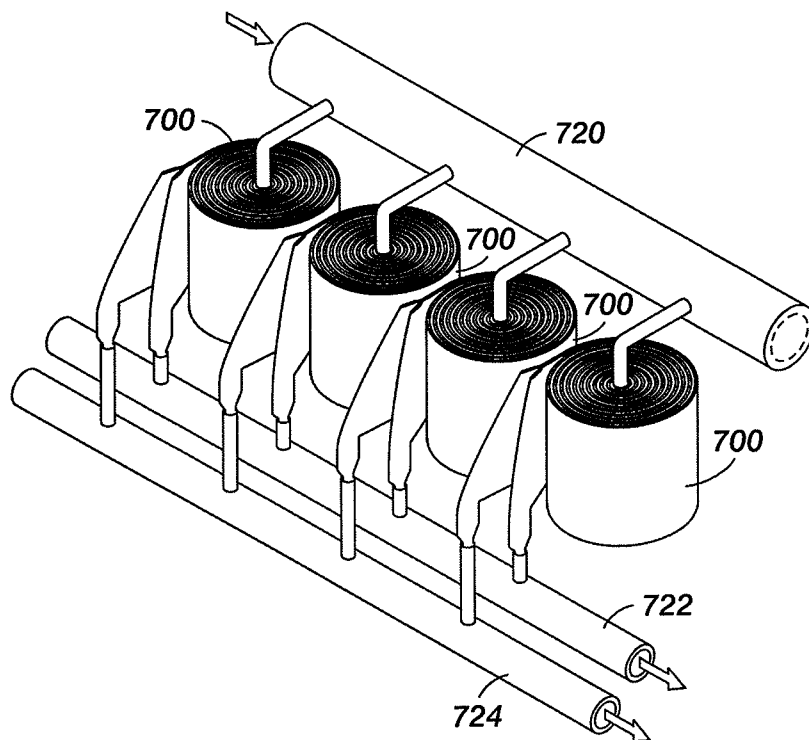
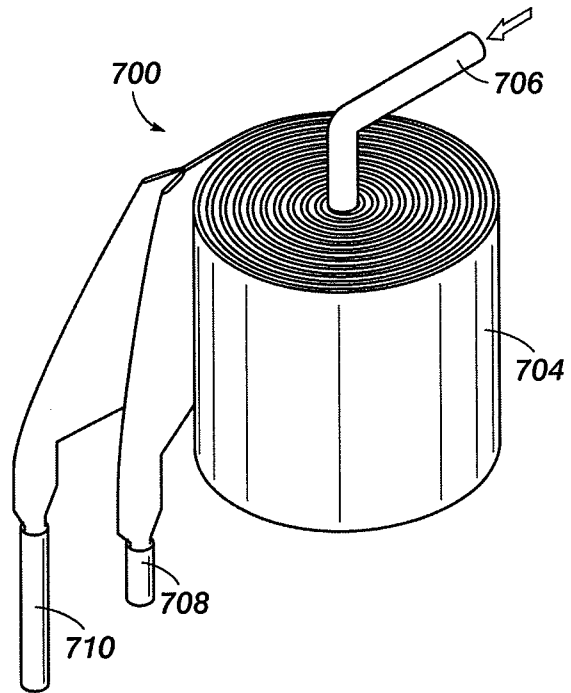


FIG. 6(b)

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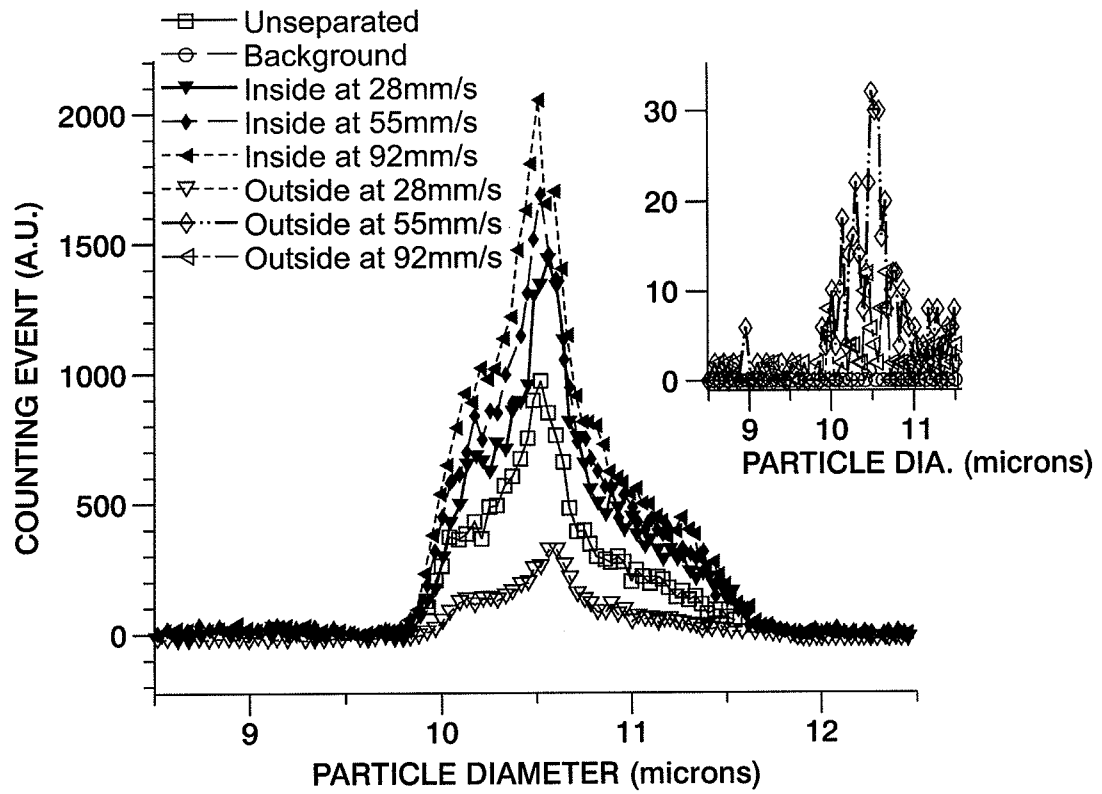


FIG. 7(a)

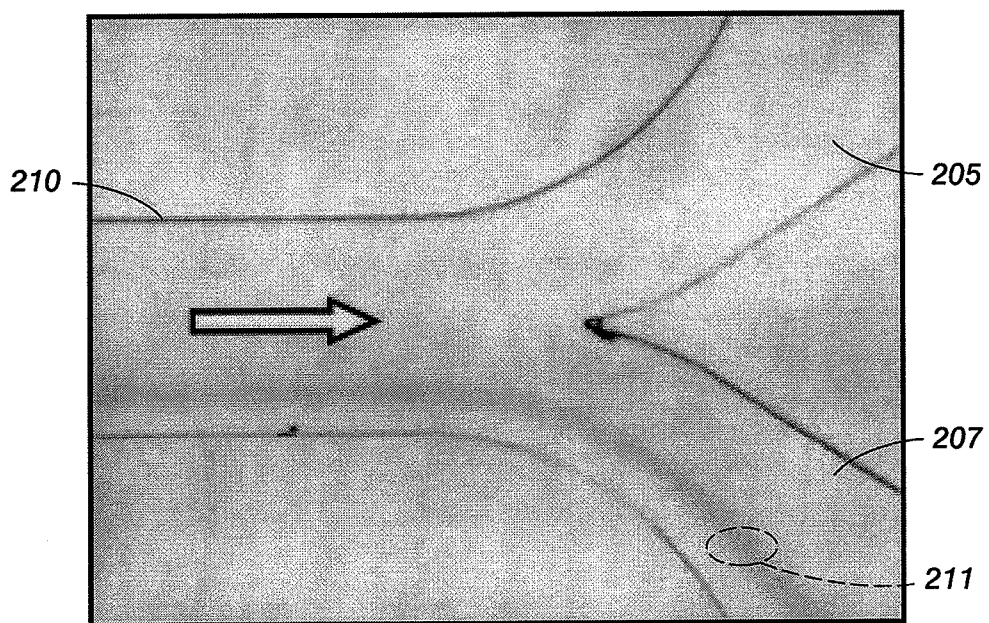


FIG. 7(b)

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PARTICLE DIAMETER (μm)	r^6/λ^4	r^4/λ^2	r^2	ESTIMATED HAZE (NTU)
1	0.61	0.40	0.25	0.78
2	39.06	6.25	1.00	2.53
3	444.95	31.64	2.25	6.21
4	2500.00	100.00	4.00	12.70
5	9536.74	244.14	6.25	22.80
6	28476.56	506.25	9.00	37.10
7	71807.25	937.89	12.25	55.50
8	160000.00	1600.00	16.00	76.80
9	324365.85	2562.89	20.25	98.90
10	610351.56	3906.25	25.00	119.00
LIGHT WAVELENGTH = 400 nm NTU = NEPHELOMETRIC TURBIDITY UNITS 1,200 SPHERICAL PARTICLES PER MILLILITER FOR MONODISPERSE SUSPENSIONS				

FIG. 8

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CITY WHERE PLANT IS LOCATED	RIVER SYSTEM FROM WHICH RAW WATER IS DRAWN	AVERAGE MONTHLY PRODUCTION (1,000 Gal.)	RAW WATER TURBIDITY	RAW WATER pH	CHEMICAL COST PER MILLION GALLONS	CHEMICAL COST PER MILLION GALLONS/ TURBIDITY UNIT
ARCHER CITY	RED	8684	89.16	7.9	71.46	0.80
BALLINGER*	COLORADO	19201	16.74	7.8	20.21	1.21
BIG SPRING	COLORADO	177000	35.00	8.2	25.66	0.73
BRENNHAM	BRAZOS	63925	6.22	7.8	133.53	21.47
EDINBURGH*	RIO GRANDE	130380	9.30	7.8	32.63	3.51
HARLINGEN 1*	RIO GRANDE	190460	36.30	8.2	197.51	5.46
HARLINGEN 2*	RIO GRANDE	114730	27.90	8.2	286.14	10.26
HENRIETTA	RED	15654	25.75	8.2	134.65	5.23
LUBBOCK*	BRAZOS	881930	7.34	8.4	32.32	4.40
TEMPLE	BRAZOS	416630	5.85	7.7	58.30	9.97
WACO 1	BRAZOS	343870	11.22	7.8	34.88	3.11
WACO 26	BRAZOS	305730	9.79	7.8	32.23	3.29
MEAN 12 PLANTS		222350	23.05	8.0	88.38	5.79
* DENOTES PLANT WITH POTENTIAL OR ACTUAL GROUND WATER CONTAMINATION AS REPORTED BY THE TEXAS WATER COMMISSION [1989].						
WATER RESOURCES RESEARCH, 34(4), 849-854 (1998)						

TURBIDITY REDUCTION
 43,300 x 23 x \$5.79 = \$5.766 M/DAY
 (\$2.104 B/YEAR)

FIG. 9

REMOVING 1–3 MICRONS PIN FLOC
ELIMINATES FLOCCULATION STEP
AND HALVES PROCESS TIME

COAGULATION AND SEDIMENTATION TIMES				
PARTICLE SIZE a(microns)	COAGULATION TIME (min.)	SEDIMENTATION VELOCITY (cm/s)	SEDIMENTATION TIME (min.)	
0.03	0.00	1.029e-8	9.873e8	
1.00	20.00	1.143e-5	8.886e6	
3.00	26.27	1.029e-4	98,736.63	
30.00	39.40	1.029e-2	987.37	
50.00	42.31	2.858e-2	355.45	
70.00	44.23	5.602e-2	181.35	
100.00	46.27	0.114	88.86	
300.00	52.53	1.029	9.87	

$$a = a_0 e^{kt} \quad k = 2.922e-3 \text{ (1/s)}$$

FIG. 10(a)

US DAILY WATER USAGE 2000		
APPLICATION	VOLUME (mgd)	PERCENTAGE (%)
Thermoelectric Power	195,000	48.00
Public Supply	43,300	10.60
Irrigation	137,000	33.58
Domestic	3,590	0.88
Livestock	1,760	0.43
Aquaculture	3,700	0.91
Industrial	19,700	4.83
Mining	3,490	0.86
TOTALS	408,000	100.00
Source: USGS Water Usage Report 2000		

ASSUME FLOCCULATION COST IS
 50% OF ALL CHEMICAL COST
 $43,300 \times \$88.38 \times 0.50 = \1.913 M/DAY
 (\$698.4 M/YEAR)

FIG. 10(b)

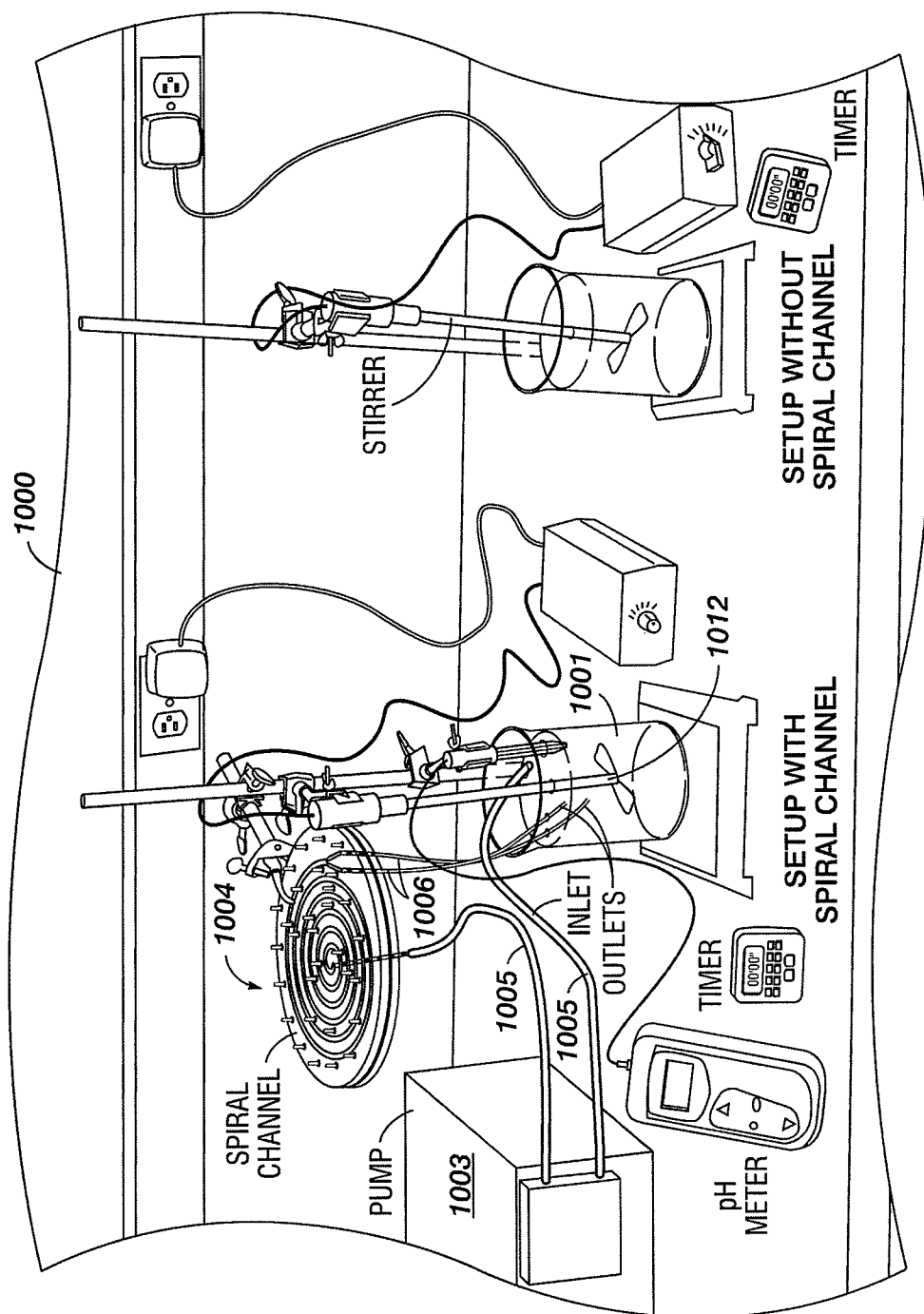
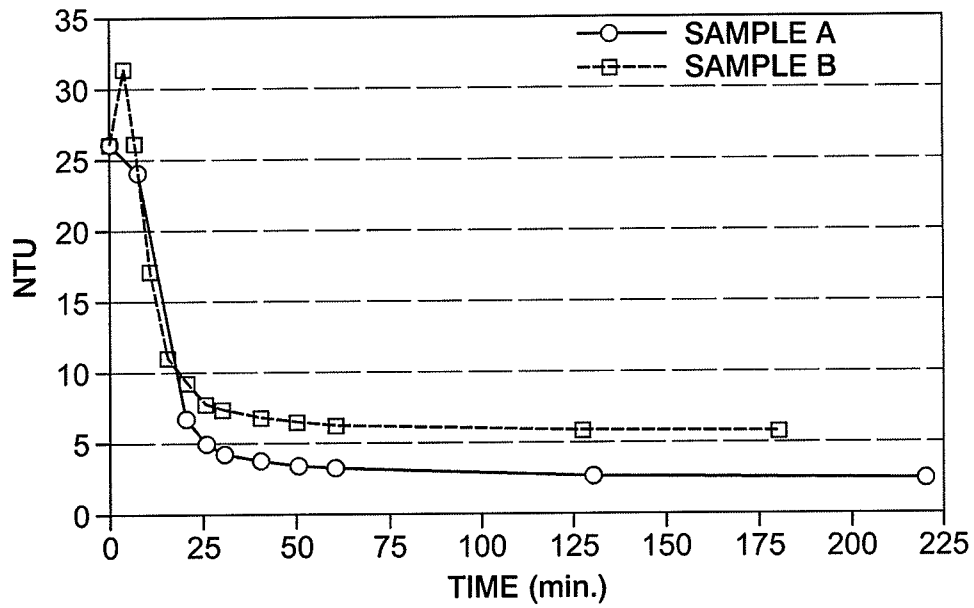
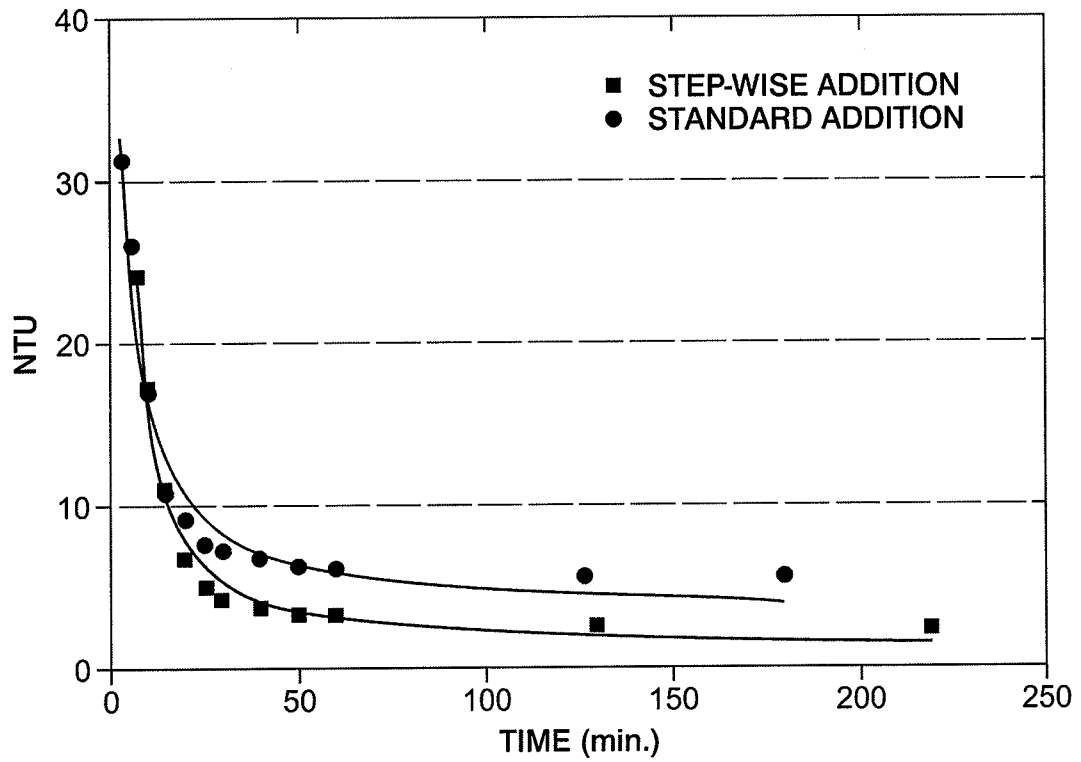


FIG. 11

**FIG. 12****FIG. 13**

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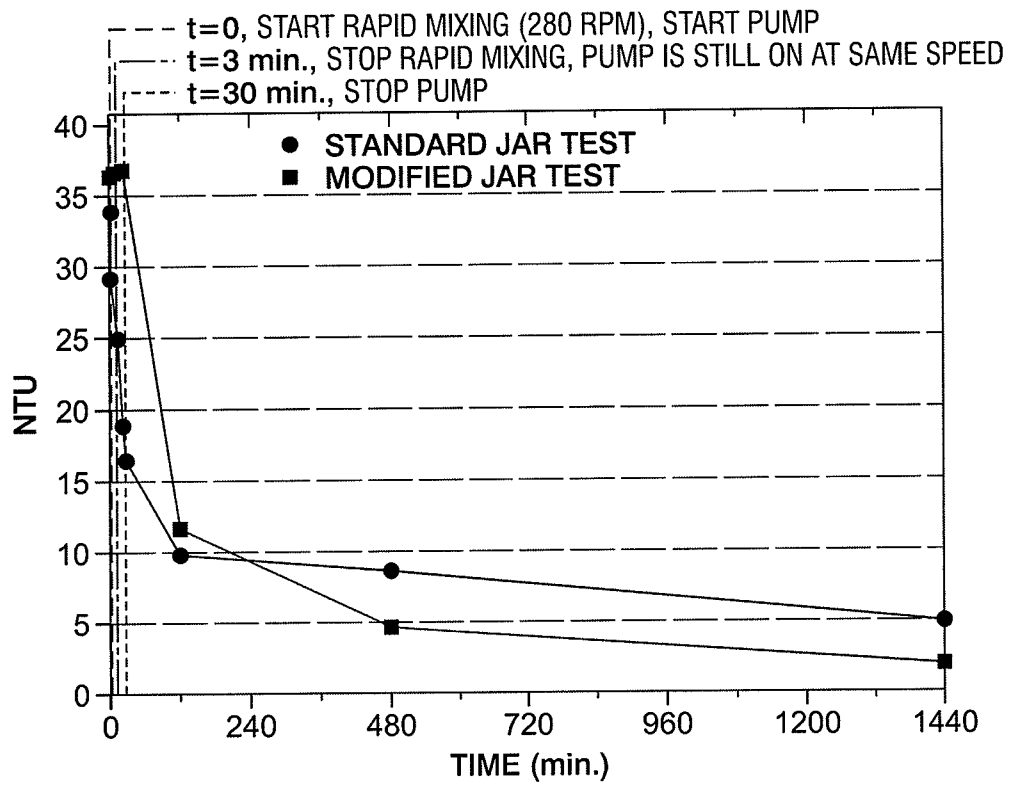


FIG. 14(a)

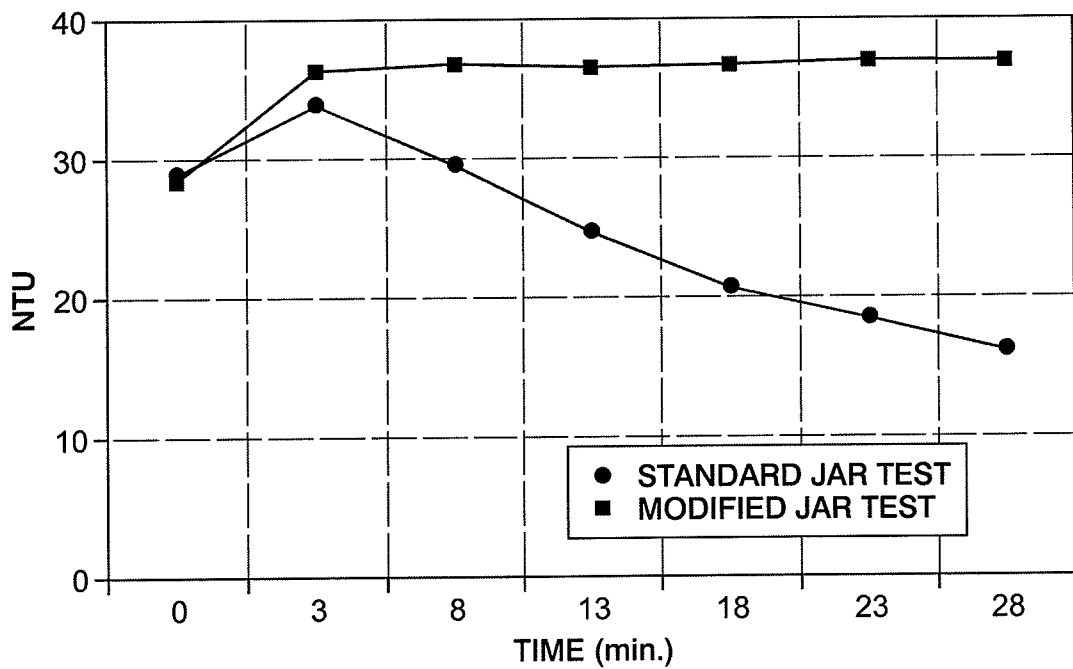
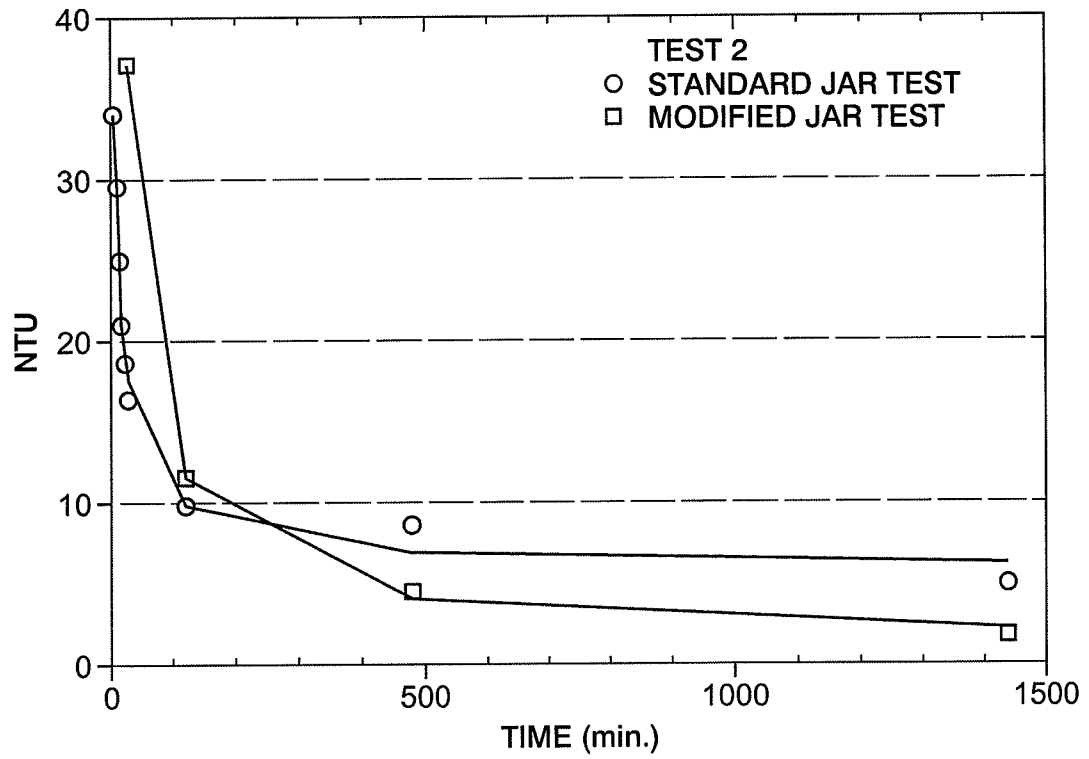


FIG. 14(b)

**FIG. 15**