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HW--40694

DE93 003443

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This document consists of 12 pages, No. 11 of 11 copies. Series A.

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FUTURE ACID, SILICATE AND SILICA REQUIREMENTS - 100 AREAS

December 30, 1955

Classification Canceled (Change to

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By Authority of CG-PR-2

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FUTURE ACID, SILICATE, AND SILICA REQUIREMENTS - 100 AREAS

The following tables give the computed acid, silicate, and silica requirements which will be necessary after completion of the water treatment plant expansion programs.

BASES:

I. The maximum feed rates to be expected are:

Activated silica - 5.0 ppm as SiO_2
Acid for pH 7.3 - 5.0 ppm as 100% H_2SO_4
Acid for pH 7.0 - 16.0 ppm as 100% H_2SO_4

II. The average feed rates to be expected are:

Activated silica - 2.5 ppm as SiO_2
Acid for pH 7.3 - 2.5 ppm as 100% H_2SO_4
Acid for pH 7.0 - 10.5 ppm as 100% H_2SO_4

III. The water plant flows will be:

183-B	82,000 gpm
183-D	94,500 gpm
183-F	82,000 gpm
183-H	82,000 gpm
183-DR	67,000 gpm
183-C	105,000 gpm
183-KE	156,000 gpm
183-KW	156,000 gpm

IV. The solutions to be used have the following properties:

Sulfuric acid--

93% H_2SO_4
15.29 lbs. per gal.
(See special curve for viscosity.)

Sodium silicate -

8.8% Na_2O
28.2% SiO_2
11.62 lbs. per gal.
(See special curve for viscosity.)

Activated silica -

A. 0.6% SiO₂

8.39 lbs. per gal.

Prepared by the following steps:

1. Raw silicate is diluted to 1.61% SiO₂
2. Acid is diluted to 5% H₂SO₄.
3. The two solutions are flash mixed in such proportions that 95% of the Na₂O content is neutralized. The resulting solution is 1.4% SiO₂.
4. The solution is aged for ten minutes.
5. The solution is diluted to 0.6% SiO₂.

This silica will be referred to as "95%" silica.

B. 1.0% SiO₂

8.44 lbs. per gal.

Prepared by the following steps:

1. Raw silicate is diluted to 1.72 % SiO₂.
2. Acid is diluted to 5% H₂SO₄.
3. The two solutions are flash mixed in such proportions that 85% of the Na₂O content is neutralized. The resulting solution is 1.5% SiO₂.
4. The solution is aged for one hour.
5. The solution is diluted to 1.0% SiO₂.

This silica will be referred to as "85%" silica.

- C. It is to be recognized that variations in the above figures will occur in actual practice. When prepared properly the viscosities of the final solutions are but slightly greater than that of water.

- V. The acid for pH control will be diluted to less than 10% by weight before adding to the raw water.

FORMULAE

Let W = thousands of gpm of raw water to be treated

P = parts per million feed rate of SiO_2

R = parts per million feed rate of H_2SO_4

gpm 0.6 % silica = 0.1656 WP

gpm 1.0 % silica = 0.0988 WP

gpm 1.4% silica = 0.0702 WP

gpm 1.5% silica = 0.0655 WP

gpm silicate for silica = 0.00255 WP

gpm 93% acid for "85%" silica = 0.000246 WP

gpm silicate dil. H_2O for "85%" silica = 0.05471 WP

gpm acid dil. H_2O for "85%" silica = 0.00796 WP

gpm final dil. H_2O for "85%" silica = 0.03334 WP

gpm 93% acid for "95%" silica = 0.000275 WP

gpm silicate dil. H_2O for "95%" silica = 0.05849 WP

gpm acid dil. H_2O for "95%" silica = 0.00889 WP

gpm final dil. H_2O for "95%" silica = 0.09527 WP

gpm acid for pH control = 0.000586 WP

gpm acid dil. H_2O => 0.00892 WP

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183-C-B

C area has a semi-continuous silica manufacturing facility. B area silica is supplied from C. The acid for pH control will be supplied from C area by two sets of proportioning pumps, one set for C, one set for B. The acid will be diluted and split just prior to addition to the raw water.

	<u>MAXIMUMS</u>				<u>AVERAGES</u>		
"95%" silica	C	B	BOTH		C	B	BOTH
gpm 0.6%	86.94	67.90	154.84		43.47	33.95	77.42
gpm 1.4%	36.86	28.78	65.64		18.43	14.39	32.82
gpm silicate	1.34	1.05	2.38		.67	.52	1.19
gpm silicate dil.	30.71	23.98	54.69		15.35	11.99	27.35
gpm acid	.14	.11	.26		.07	.06	.13
gpm acid dil.	4.67	3.64	8.31		2.33	1.82	4.16
gpm final dil.	50.02	39.06	89.08		25.01	19.53	44.54

"85%" silica

gpm 1.0%	51.87	40.51	92.38		25.94	20.25	46.19
gpm 1.5%	34.39	26.86	61.24		17.20	13.43	30.63
gpm silicate	1.34	1.05	2.38		.67	.52	1.19
gpm silicate dil.	28.72	22.43	51.14		14.36	11.22	25.58
gpm acid	.13	.10	.23		.06	.05	.12
gpm acid dil.	4.18	3.26	7.44		2.09	1.63	3.72
gpm final dil.	17.50	13.67	31.17		8.76	6.84	15.60

pH 7.3

gpm acid	.31	.24	.55		.15	.12	.27
minimum gpm dil.	4.7	3.7	---		2.3	1.8	---

pH 7.0

gpm acid	.98	.77	1.75		.65	.50	1.15
minimum gpm dil.	15.0	11.7	---		9.8	7.7	---

183-D-DR

D area will have a continuous silica manufacturing facility. DR will be supplied from D. Each area will have completely independent acid systems for pH control.

	<u>MAXIMUMS</u>			<u>AVERAGES</u>		
	D	DR	BOTH	D	DR	BOTH
"95%" silica						
gpm 0.6%	78.25	55.48	142.00	39.12	27.74	71.00
gpm 1.4%	33.17	23.52	60.20	16.58	11.76	30.10
gpm silicate	1.20	.85	2.19	.60	.43	1.09
gpm silicate dil.	27.64	19.59	50.16	13.82	9.80	25.08
gpm acid	.13	.09	.24	.06	.05	.12
gpm acid dil.	4.20	2.99	7.62	2.10	1.49	3.81
gpm final dil.	15.02	31.92	81.69	22.51	15.96	40.85

"85%" silica

Will not be made at D but might be imported by truck.

gpm 1.0%	46.68	33.10	84.72	23.34	16.55	42.36
gpm 1.5%	30.95	21.94	56.17	15.47	10.97	28.08
gpm final dil.	15.75	11.17	28.58	7.88	5.58	14.29

pH 7.3

gpm acid	.28	.20	---	.14	.10	---
minimum gpm dil.	4.2	3.0	---	2.1	1.5	---

pH 7.0

gpm acid	.89	.63	---	.58	.41	---
minimum gpm dil.	13.5	9.6	---	8.9	6.3	---

183-F

F area will have a continuous silica manufacturing facility. It will also have a complete acid addition facility.

	<u>MAXIMUM</u>	<u>AVERAGE</u>
"95%" silica		
gpm 0.6%	67.90	33.95
gpm 1.4%	28.78	14.39
gpm silicate	1.05	.52
gpm silicate dil.	23.98	11.99
gpm acid	.11	.06
gpm acid dil.	3.64	1.82
gpm final dil.	39.06	19.53

"85%" silica

Will not be made at F but might be imported by truck.

gpm 1.0%	40.51	20.25
gpm 1.5%	26.86	13.43
gpm final dil.	13.67	6.83

pH 7.3

gpm acid	.24	.12
minimum gpm dil.	3.7	1.8

pH 7.0

gpm acid	.77	.50
minimum gpm dil.	11.7	7.7

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183-H

H area will import 1.5% silica from KE area and dilute it to 1.0% for storage and feeding. A complete acid addition facility will be installed.

	<u>MAXIMUM</u>	<u>AVERAGE</u>
"85%" silica		
gpm 1.0%	40.51	20.25
gpm 1.5%	26.86	13.43
gpm final dil.	13.67	6.83
pH 7.3		
gpm acid	.24	.12
minimum gpm dil.	3.7	1.8
pH 7.0		
gpm acid	.77	.50
minimum gpm dil.	11.7	7.7

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183-KE-KW

Each of the K areas are self-sufficient and identical with the exception of one silica facility at KE which will make 1.5% silica for export to H area. It is not known at present whether or not the silica for the K's will be changed to "95%" silica.

	<u>MAXIMUM</u>	<u>AVERAGE</u>
"95%" silica		
gpm 0.6%	129.17	64.58
gpm 1.4%	54.76	27.38
gpm silicate	1.99	.99
gpm silicate dil.	45.62	22.81
gpm acid	.21	.11
gpm acid dil.	6.93	3.47
gpm final dil. •	74.31	37.16

	for K	for H	for K	for H
"85%" silica				
gpm 1.0%	77.06	40.51	38.53	20.25
gpm 1.5%	51.09	26.86	25.55	13.43
gpm silicate	1.99	1.05	.99	.52
gpm silicate dil.	42.67	22.43	21.34	11.22
gpm acid	.19	.10	.10	.05
gpm acid dil.	6.21	3.26	3.10	1.63
gpm final dil.	26.00	13.67	13.00	6.83

pH 7.3

gpm acid	.46	.23
min. gpm dil.	7.0	3.5

pH 7.0

gpm acid	1.46	.96
min. gpm dil.	22.3 •	14.6

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CONTINUOUS SILICA MACHINES

The multiple-unit systems to be installed at D and F utilize machines which are rated at 74.9 pounds per hour of SiO₂. The following flows will be required per machine at this rate of production of "95%" silica.

	<u>gpm</u>	<u>gph</u>	<u>#/min</u>	<u>#/hr</u>
Raw sodium silicate	0.38	22.89	4.43	265.98
Concentrated acid	0.04	2.47	0.63	37.80
Silicate dilution H ₂ O	8.76	525.49	73.02	4,381.02
Acid dilution H ₂ O	1.33	79.79	11.09	665.20
1.4% solution	10.52	630.90	89.17	5,350.00
Final dilution H ₂ O	14.26	855.57	118.89	7,133.33
0.6% solution	24.80	1487.76	208.06	12,483.33

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VISCOSITY OF SODIUM SILICATE

(41 Baume)

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VISCOSITY OF SULFURIC ACID
(66° Baume)

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