

Industrial Application of Precipitate SiO₂ Obtained from Water Glass

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Summary. The precipitate SiO₂ is a residue from water glass with silicate module 2.5 and it is a white amorphous powder. The quality of the obtained product is accomplished with the strict control of the basic process parameters, like: concentration of the raw material, temperature, pH and active control of the technological operations: filtrating, drying and packing. The precipitate SiO₂ is build from primary particles with size of 12 nm and they are forming aggregates that are linked and form a chained structure. SiO₂ is used as active white loader for natural and artificial elastomers for obtaining auto gums, in the paper industry, for thermo isolation, in the color industry, like an adsorbent etc. This wide usage of the product is a result of his structure.

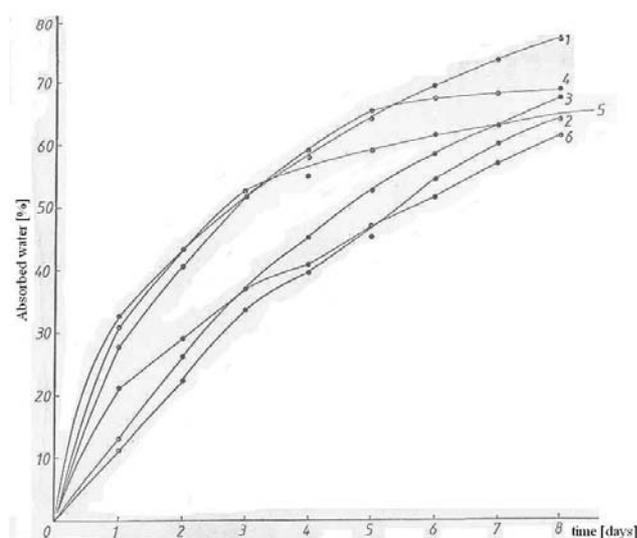


Figure 1. Application of the precipitate SiO₂ as an adsorbent

The material used for obtaining of the precipitate SiO₂ is a water glass with exact and known silicate module which is obtained from white opalized tuff from the location Strmos-Republic of Macedonia using the wet-procedure, chloric (HCl) or sulphuric (H₂SO₄) acid with known concentration and supplements for better quality.

The precipitate SiO₂ has the following chemical structure: SiO₂ (more than 90%), the loss of mass in the heating process is less than 8%, pH (5%) between 5.9 and 8 and the specific surface according to B.E.T. is between 100 and 260 m²/g.

In this work, we will show the results from the researches of precipitate SiO₂ like an adsorbent and as a loader in the industry of gums.

Introduction

The precipitate SiO_2 is a residue from hydrated Na-silicates and it is obtained with acidic-procedure. The precipitate is a white amorphous powder, which has great dispersion and greater chemical activity than crystal SiO_2 .

In this paper, we are trying to show the possible applications of precipitate SiO_2 in the industry. First we shall talk about the obtaining of precipitate experimentally, then it's applications and at the end some discussion for the results.

Experimental

The precipitate is obtained using wet-procedure from white opalized tuff from the location Strmos-Macedonia. The precipitation is made with chloric acid with different concentrations. We obtained three different samples:

- Sample 1: in hydrated Na-silicate 30 cm^3 concentrated chloric acid is added;
- Sample 2: in hydrated Na-silicate 40 cm^3 concentrated chloric acid is added;
- Sample 3: is the precipitate SiO_2 , obtained from hydrated Na-silicate with silicate module 2.5.

The obtained silicates are washed until the $\text{pH}=7$ is reached and then dried at the temperature 433-443K. At those samples, the adsorption of the steam is measured on every 24 hours. Results for the adsorption are given in Table 1 and Figure 1.

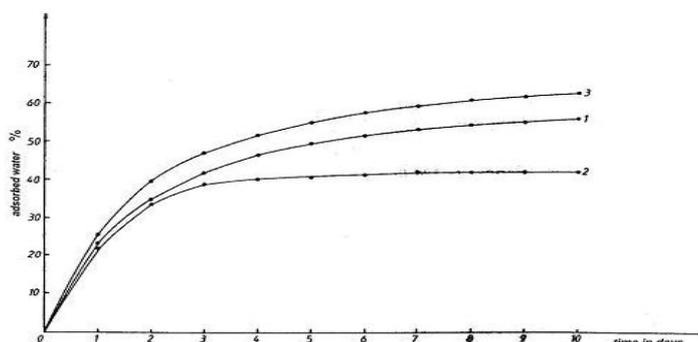


Figure 1. Dependency of the adsorbent quantity of water from the time in the precipitate SiO_2 dried at 433-443K for samples obtained with different concentration of acid added in a unit of hydrated Na-silicate: 1- 30 cm^3 concentrated, 2- 40 cm^3 concentrated and 3- solution 1:1 30 cm^3 chloric acid

Table 1. The quantity of adsorbed water in the precipitate SiO_2 dried at 433-443K in dependency of time

Sample	Days/Adsorbed water in % wt									
	1	2	3	4	5	6	7	8	9	10
1	23.42	38.84	42.05	46.57	49.61	51.80	53.65	55.08	55.97	56.92
2	21.99	33.80	38.67	40.21	40.85	51.52	42.11	42.39	42.50	42.48
3	25.40	39.50	47.28	51.99	55.21	57.69	59.71	61.29	62.40	63.52

From the same hydrated Na-silicate, with silicate module 2.5, the precipitate SiO_2 is obtained by precipitation with inverse method. We prepared four different samples: sample 11, sample 12, sample 13 and sample 14.

We obtained the samples 11 and 13 when we added in 40 cm^3 concentrated chloric acid 10 g hydrated Na-silicate and the samples 12 and 14 when in 10 g hydrated Na-silicate we added 40 cm^3 concentrated chloric acid. The temperature for precipitation is constant and it is 323 K.

The precipitate SiO_2 (samples 12 and 13) is washed with solution of chloric acid (pH=6), and the samples 11 and 14 with solution of NaOH (pH=8). When the desired pH level is reached, all samples are washed with distilled water (pH=7), dried at 383K, and then activated for 2 hours at 573K.

The results from the adsorption at steam are shown in Table 2 and Figure 2.

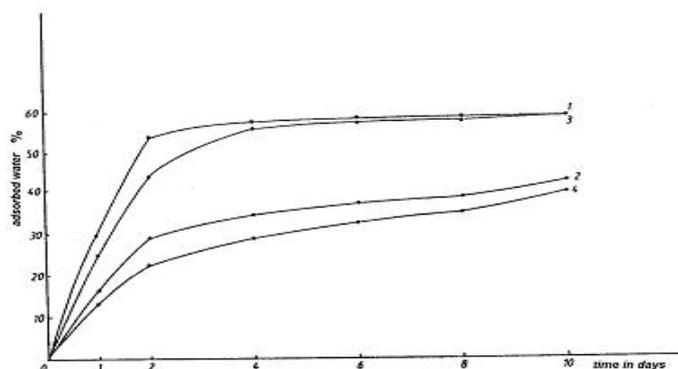


Figure 2. Dependency of the adsorbent quantity of water from time in precipitate SiO_2 which is thermally-activated at 573K and it is obtained with inverse method with different pH wash: 1 -sample 11 (inverse method with alkali wash), 2 - sample 12 (normal method with acidic wash), 3 - sample 13 (normal method with acidic wash) and 4 - sample 14 (normal method with alkali wash)

Table 2. The quantity of adsorbed water in the precipitate SiO_2 dried for 2 hours 573K in dependency of time

Sample	Days/Adsorbed water in % wt					
	1	2	4	6	8	10
11	30.80	54.19	57.52	58.14	58.51	59.72
12	16.99	29.42	34.82	37.31	39.08	43.16
13	25.41	44.73	56.23	57.41	58.24	59.35
14	13.55	22.88	29.15	32.85	35.39	40.42

There is a technological scheme for industrial production of precipitate SiO_2 from water glass and it is given on Figure 3.

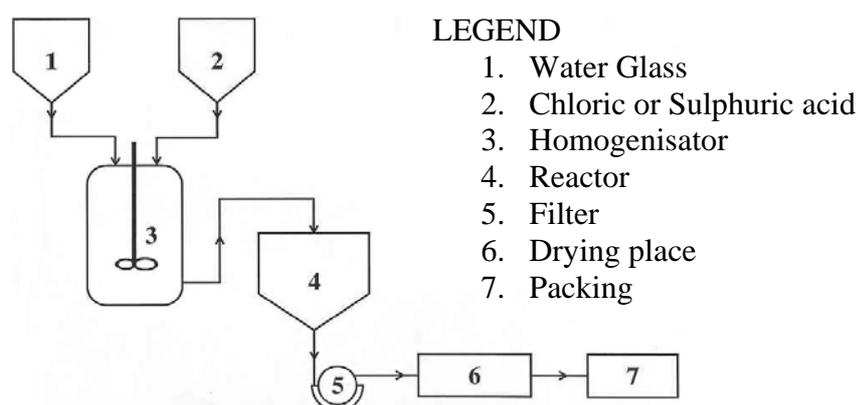


Figure 3. Technological Scheme for obtaining precipitate SiO_2

We applied the precipitate as loader in the rubber industry. The activation curves for precipitate SiO_2 with alkali (NaOH) are given on Figure 4.

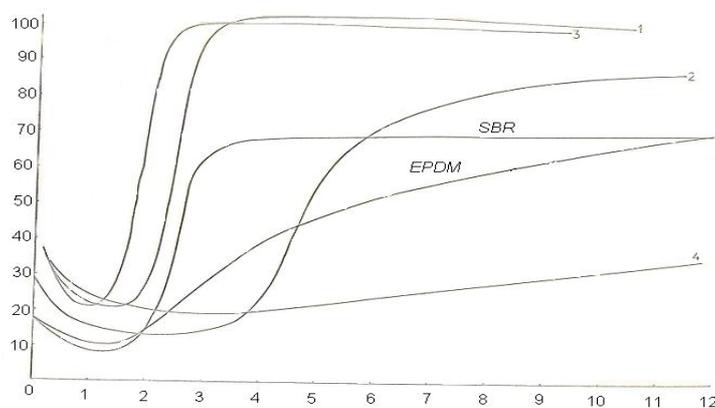


Figure 4. Activation curve for precipitate SiO_2

There are many other applications of the precipitate as an adsorbent in color industry, for thermo isolation, etc. This wide usage of precipitate is due to his structure.

Conclusion

The obtained results for the adsorption features of the amorphous precipitate SiO_2 , which is obtained with adding chloric acid in hydrated Na-silicate; show that when using solutions greater adsorption features are obtained.

The investigations of adsorption features of the precipitate SiO_2 , obtained with inverse method, showed that in that case these features are enlarged.

With changing the technological parameters, such as concentration, pH level, temperature and the manner of mixing the reaction mixture, we can obtain products that can be used as adsorbents and loaders.

References

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