RESEARCH OF TECHNOLOGY FEATURES OF SODA PRODUCTION

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Abstract. *The basic block diagram of the technological process of soda production is analyzed. The functional scheme of carbonation and absorption columns and the properties of the liquid and gas phases in the production of soda have been studied. Functional relationships between the parameters of absorption and carbonation processes were considered as an object of mathematical modeling.*

Keywords: *absorption, carbonation column, pressure, concentration, flow rate.*

It is one of the most important products of the basic chemical industry. Soda ash is widely used in many industries, as well as for household needs.

The main raw materials for the production of soda ash are sodium chloride (salt) and calcium carbonate (limestone). On the territory of Uzbekistan, there are all the main types of raw materials for its production [1-3].

One of the typical modeling objects is the technological scheme of soda ash production (Fig. 1).

The functioning of the technological scheme of soda production is carried out as follows. An aqueous solution of table salt, previously purified from calcium and magnesium salts, enters the brine purification section 1. In the absorption section 3, the purified brine is absorbed by ammonia and partially by carbon dioxide. Part of the ammonia lost during production is replaced by gaseous ammonia. The ammoniated brine is pumped 4 to the carbonization section 5. Here the ammoniated brine is saturated with carbon dioxide supplied by compressors from the compression section 10, resulting in the formation of sodium bicarbonate.

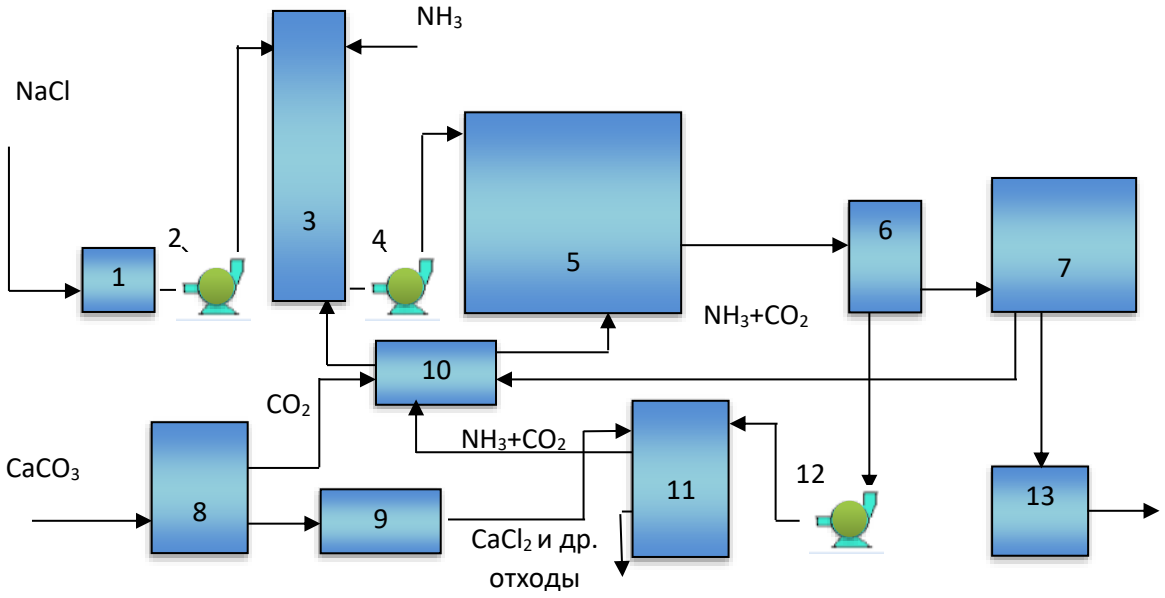

Fig. 1. Technological scheme of the production of soda ash. 1-brine cleaning, 2,4,12-pumps, 3-absorption department, 5-carbonization department, 6 filtration, 7-calcination department, 8 - roasting department, 9 quenching department, 10-compression department, 11-distillation, 13 - department of heavy soda.

The precipitated sodium bicarbonate is separated from the liquid using a drum vacuum filter in the filtration section 6. The filtered liquids are sent to the distillation section 11 by pumps 12, and the sodium bicarbonate is fed into the calcination section [2,3].

In calcination section 7, wet sodium bicarbonate decomposes when heated in calciners to form light soda ash.

Light soda ash has poor thermal conductivity and occupies a large volume. To change the crystal structure in industry, the method of recrystallization of soda ash in solution is used. At the same time, soda with a large bulk mass is obtained, heavy soda ash, in the department of heavy soda 13. In the distillation department, ammonia is regenerated from the ammonium salts contained in the liquid filtered from the precipitate of sodium bicarbonate. To do this, the filter fluid is treated with steam and lime milk. The separated ammonia is returned to absorption section 3.

According to [4], each compartment consists of several complexes, in turn, the complexes consist of several apparatuses and devices in which various physical and chemical processes occur (kinetic, heat and mass transfer, hydrodynamic, and others).

For the purpose of analysis, we present the structure of physicochemical processes and their interaction in the following form (Fig. 2).

On fig. 2 table salt (TS), heavy soda ash (SA), limestone (L), $CaCl_2$ and other wastes (W), at intermediate stages, individual intermediates P_i(I = 1,2,…,15). J_i (I = 1,2,…,10) departments in which technological processes take place (devices, devices), F_i(I = 1,2,…,10) – control actions.

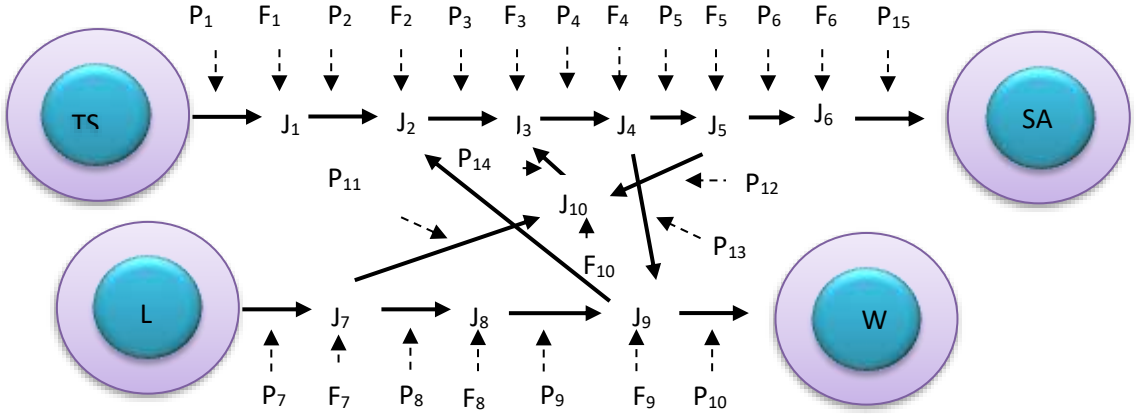

Fig 2. The structure of physical and chemical processes and their interaction.

It has been established that the main processes for the production of soda ash are the separations of absorption and carbonization. Therefore, we will further consider the main devices of these departments, the tasks of their automation, as well as approaches to the mathematical modeling of such processes.

The absorption section uses bubbling and scrubber type devices to absorb NH_3 and CO_2. Modern and newly built soda plants are equipped with bubbling-type apparatuses with a counter flow of gas and liquid. Bubbling apparatuses are vertical columns consisting of a number of barrels connected by rubber gaskets and bolted together. Each bubbling barrel has a special device - a bubbling plate, on which there is close contact between gas and liquid. The apparatus has several such plates sandwiched between flanges. When gas passes through the brine layer, foaming of the liquid occurs, which contributes to better contact between the gas and liquid phases.

To reduce equipment corrosion, sulfides are introduced into the brine, while the internal surfaces of the apparatus are covered with a thin layer of iron sulfide, which protects the equipment from further corrosion.

At operating soda enterprises, a process control system has been introduced at stations in absorption departments, which collects, primary processes information about the parameters of the technological regime, promptly

calculates the main technical and economic indicators of the process and issues these data to the operator.

The main parameter of the absorption section is the flow of the filter liquid into the distillation column, which simultaneously determines the load of the absorption apparatus by the amount of absorbed ammonia. The main streams, including the purified brine for absorption and the water supplied to the cooling of the apparatus of the absorption station, are subordinate and are coordinated with the leading stream.

The main apparatuses of the carbonization department are the carbonization columns and the first column gas scrubber.

The carbonization (precipitation) column is a vertical cylindrical bubbling-type apparatus, consisting of separate cast-iron barrels and a drawer(similar to an absorption column) [2].

The first gas washer of the column (GWC-1) is a scrubber-type apparatus, which is a cylindrical hollow column with grates. In the upper part of the device there is a distribution irrigation plate. The dimensions of the washers are determined by the capacity of the carbonization section.

Currently, in practice, a system is used to control the processes of carbonization and pre-carbonization of ammoniated brine, which provides for the automatic supply of ammoniated brine to the pre-carbonization apparatus and maintaining the liquid level in them, stabilizing the temperature regime of pre-carbonization and the degree of saturation of the pre-carbonized liquid. The regulation of the gas load in the pre-carbonization apparatus is carried out taking into account the mode of operation of the precipitation carbonization columns.

The control system of the carbonization department of the soda ash production solves the problem of optimal combination of high productivity of column equipment with high sodium and carbon dioxide utilization rates.

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