In the second case, two reactions proceed. Calcium and magnesium bicarbonates react with calcium hydroxide, thereby eliminating temporary hardness:

$$Ca(HCO_3) + Ca(OH)_2 = 2CaCO_3 + 2H_2O,$$

and sulfates, nitrates and chlorides - with sodium carbonate, which eliminates constant hardness:

$$CaSO_4 + Na_2CO_3 \rightarrow CaCO_3 + Na_2SO_4.$$

Energy intensity of chemical production. Types and sources of energy. Alternative energy source. The essence of the complex energy-chemical use of fossil fuels and heat of exothermic processes, regeneration and reuse of energy. Energy technology schemes. Secondary energy resources. The concept of full use of energy resources. Regeneration, utilization of heat and energy

Chemical production is one of the most energy-intensive. This is the production of ammonia, phosphorus, calcium carbide, sodium carbonate, chemical fibers and plastics, which makes up more than 60% of the electric and 50% of the thermal energy of the entire industry.

The energy consumption of chemical production is estimated by its energy intensity.

Energy intensity of production is the amount of energy spent on obtaining a unit of production. It is expressed in *kW·h (kJ)* or in tons of *conventional fuel* (*CF*) per ton of production. According to energy intensity chemical production is divided into three classes:

1) Production with *conventional fuel* (*CF*) consumption of more than 2 tons ($58\text{-}10^3$ kJ) per ton of production. These include the production of chemical fibers, acetylene, caprolactam, polyethylene, acrylonitrile, etc.

2) Production with *conventional fuel* (*CF*) consumption from 1 to 2 tons ($29\cdot10^3$ - $58\cdot10^3$ kJ) per ton of production. These include the production of sodium carbonate, ammonia, calcium carbide, methanol, etc.

3) Production with *conventional fuel* (*CF*) consumption of less than 1 ton ($29\cdot10^3$ kJ) per ton of product. These include the production of diluted nitric acid, ethylene glycol, acetic acid, aniline, polystyrene, double superphosphate, etc.

The energy intensity of individual industries varies very widely: from $20\cdot10^3$ kWh for aluminum to 60-100 kWh for sulfuric acid per ton of products.

Energy is used for chemical reactions, compression of gases and liquids, heating of materials, implementation of thermal processes (rectification, evaporation, etc.), mechanical and hydrodynamic processes (grinding, filtering, etc.), transportation of materials. Electric, thermal, fuel, mechanical, light, nuclear and chemical energy is used.

The energy of electricity is used to conduct electrochemical, electrothermal, electromagnetic and electrostatic processes, as well as to move materials and actuate various mechanisms and machines.

Thermal energy is used for various purposes. High potential energy (more than 623 K) is used for high-temperature processing of raw materials (firing, etc.) and the intensification of chemical reactions. It is obtained by burning various types of fuel directly in technological devices.

Thermal energy of medium (373–623 K) and low (323–423 K) potential is used in production processes associated with changes in the physical properties of materials (heating, melting, distillation, evaporation), for heating components in chemical processes, and also for some chemical processes.

Heat transfer is carried out due to the contact of the heated system through the wall of the apparatus with a coolant having a high heat content or in direct contact with the heated material. A