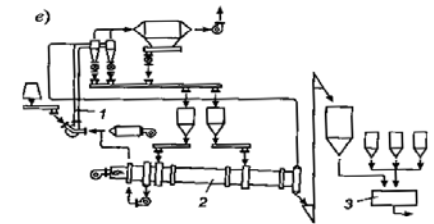
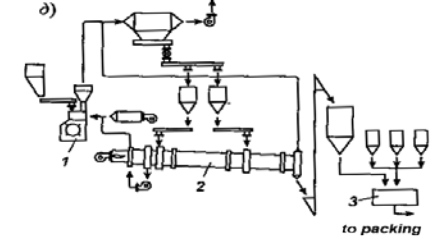
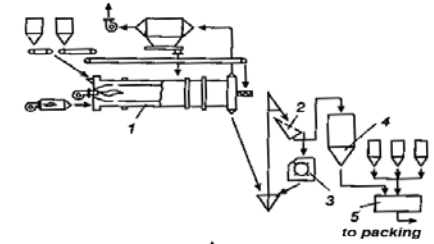
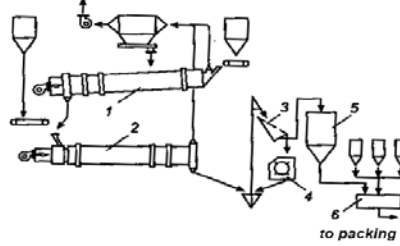
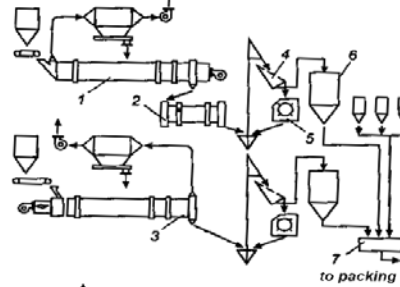
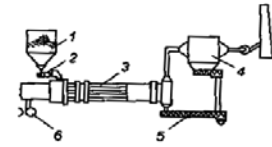


Gypsum Plaster

No.	Technology	Equipment produced by the Samara Strommashina Plant	Scheme	Advantages and disadvantages
1	<p style="text-align: center;">Using kettles of periodical action</p>	<p>Hopper, soaking hopper, chain elevator, cyclones, sleeve filters, steam line, gas line, belt conveyor, jaw crusher, disk feeder, pit (or paddle-type) mill for gypsum grinding and drying, draught machines, fans, screw conveyors, heaters, dust-laying chamber, kettle, furnace, feeders, silos</p>		<p>Advantages: a hammer (pit) mill with a gravity separator for gypsum grinding and drying; fineness of grinding and performance depend on the rate of gas flow (from the fans). Disadvantages: to increase gypsum technical (plastic) properties considerably, secondary grinding of the gypsum binding material (in ball mills) is required after boiling in the kettle.</p>
2	<p style="text-align: center;">Using kettles of continuous action</p>	<p>Hopper, cyclones, elevator, sleeve filters (instead of electrical filters), chain feeder, disk mill, mill furnace, mill fan, screw conveyors, kettle, gypsum cooler, kettle furnace, exhauster, cooler fan, electrical filter, exhaust gas fan</p>		<p>Advantages: improved design, maximum automation; the continuous supply of fresh gypsum dust into the kettles maintains a high degree of saturation with water vapors improving the gypsum modification composition and properties. Disadvantages: no data</p>
3	<p style="text-align: center;">Using rotary kilns (dryers) + 6 subtypes</p>	<p>Hopper, cyclones, dryer, ball (tube) mill, sleeve filters, feeders, crushers (if required), conveyors, furnace, exhauster, screen (if required)</p>		<p>Advantages: gypsum firing in furnaces (drying cylinders) may be performed under direct contact with hot gases generated after burning fuel; the fuel may be solid, liquid or gaseous; besides grinding, the product material composition gets balanced in the mill due to transition from underburning and overburning to semihydrate. Disadvantages: unlike steaming in kettles, the firing product modification composition becomes heterogeneous, with considerable underburning and overburning present.</p>

1. With a single rotary kiln
2. With two rotary kilns and a cooler
3. With two rotary kilns

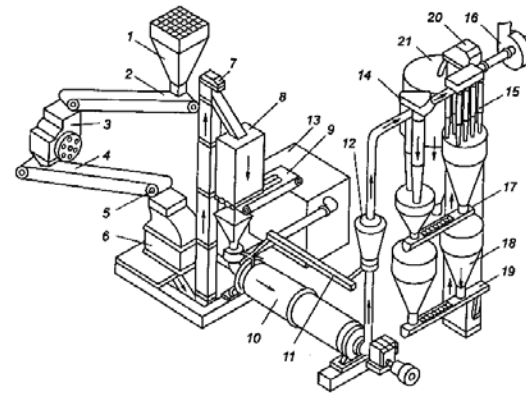


4. With a rotary two-drum kiln of high- and low-temperature firing
5. With a two-zone rotary kiln
6. With a two-zone rotary kiln and a suspended state dryer

4

Using units of combined grinding and firing

Hoppers, elevator, ball mill, cyclones, sleeve filters, belt conveyor, jaw crusher, magnetic separator, hammer crusher, drum valve, screw conveyor, air separator, furnace (13), high-pressure fan

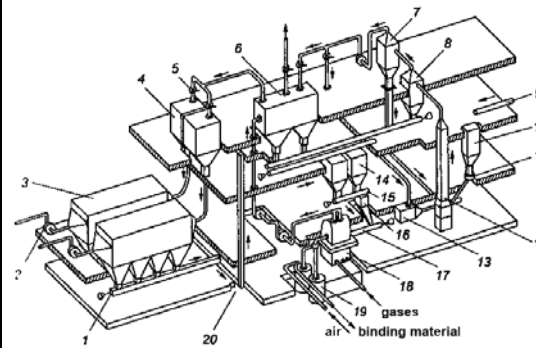


Advantages: combined fine grinding and firing in pit, ball and other mills at the temperature of gases entering the mill of 60...700°C. **Disadvantages:** same as for firing in dryers

5

Firing in a boiling bed kiln (Gypsum G5...G7)

Hoppers, sleeve filter instead of electrical filter, pile of cyclones, flow, elevator, screw conveyor, fan, electrical filter, mixing chambers, throttle valve, belt conveyor, disk feeder, pit mill (12), heat generator (13), screw feeder, dehydrating kiln (18), air-actuated feeders

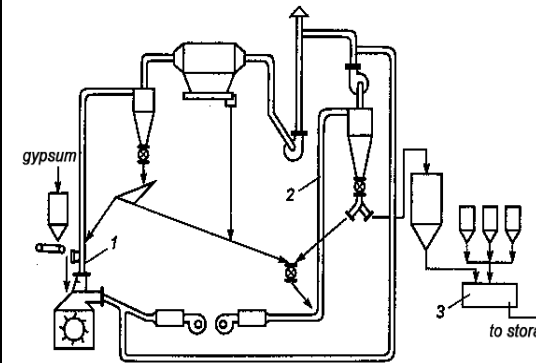


Advantages: progressive firing – hot kiln gases are fed underneath a layer of raw material of gypsum at the rate of 1-2 m/s, so the gypsum particles are not flow-removed from the bed, but fluctuate. This causes the layer "boiling".
Disadvantages: kiln gas parameters may only be changed within a short range, the available heat factor is 85%, the binding material quality depends on the timing of firing.

6

Firing in suspended condition in a drying tube

Hoppers, cyclones, sleeve filters, drying tube (1), gypsum firing tube (2), mixer (3), exhauster, fan, feeders

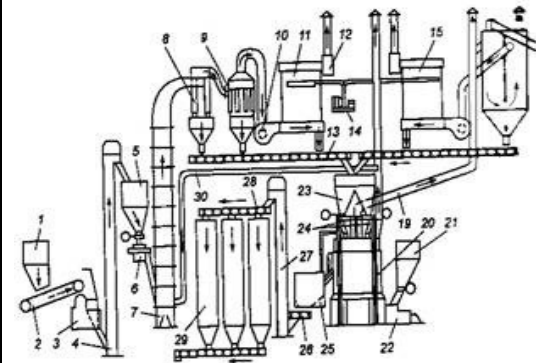


Advantages: higher intensity of firing compared with a boiling bed kiln; firing is performed in ascending gases for a few seconds (suspended particles), high rate firing. Multiphase gypsum is produced, which is then mixed with additives to produce specific types of gypsum.
Disadvantages: the sizes of a drying tube depend on the firing temperature conditions and the volume and rate of kiln gases (0.5 to 20 m); the raw material fed into the drying tube must be homogeneous, since the wide spectrum of the time of keeping various-size particles causes unequal alteration of properties.

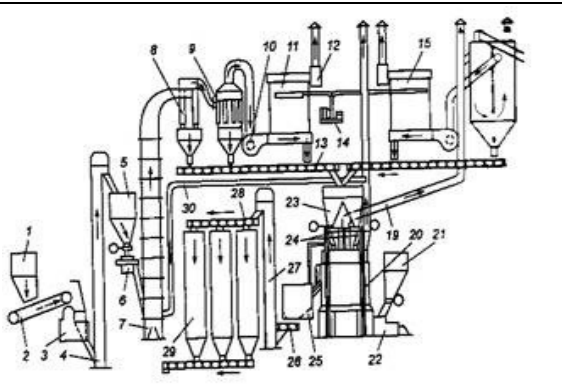
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Molding gypsum production

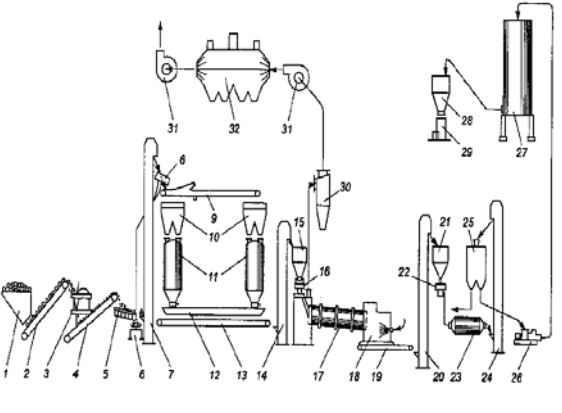
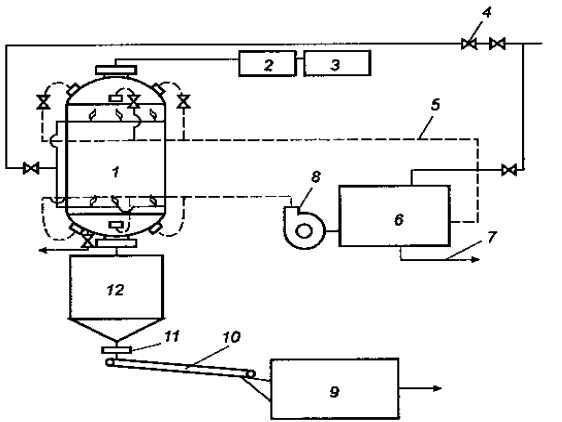
Hopper, soaking hopper, chain elevator, cyclones, sleeve filters, steam line, gas line, belt conveyor, jaw crusher, disk feeder, pit (or paddle-type) mill for gypsum grinding and drying, draught machines, fans, screw conveyors, heaters, dust-laying chamber, kettle, furnace, feeders, silos

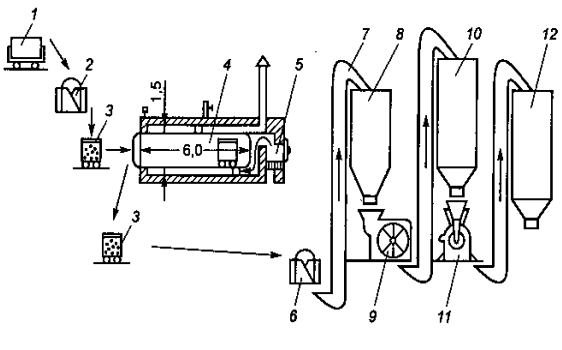
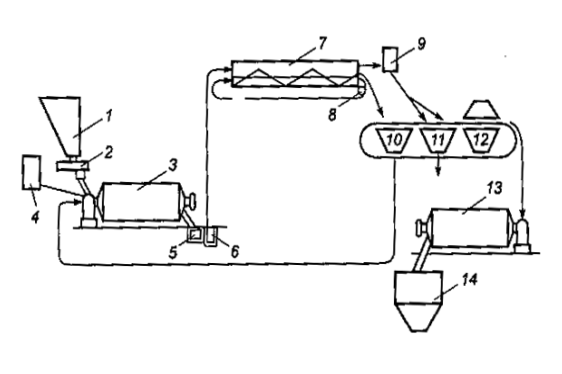


Advantages: similar to producing gypsum plaster in kettles allowing implementation of thermal treatment conditions at any duration of the cycle and along the specified temperature curve. **Disadvantages:** depending on the intended use, the molding gypsum boiling time varies within 2-4 h decreasing the performance

8	<p>Medical gypsum production</p>	<p>hopper, soaking hopper, chain elevator, cyclones, sleeve filters, steam line, gas line</p>	<p>belt conveyor, jaw crusher, disk feeder, pit (or paddle-type) mill for gypsum grinding and drying, draught machines, fans, screw conveyors, heaters, dust-laying chamber, kettle, furnace, feeders, silos</p>		<p>Advantages: no difference from producing molding or modeling gypsum. Disadvantages: requires more careful raw material selection</p>
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High-Impact Gypsum

No.	Technology	Equipment produced by the Samara Strommashina Plant	Scheme	Advantages and disadvantages
9	<p>Production of high-impact gypsum with dehydration and drying in separate units (using autoclaves)</p>	<p>Hoppers, elevator, dryer (17), ball mill (23), cyclones, sleeve filter instead of electrical filters, belt conveyor, crusher, screen, dampers (11), feeders, furnace, separator (25), air-screw pump, silo, packing machine (29), fan, electrical filter</p>		<p>Advantages: gypsum stone is steamed in the damper (autoclave) and offloaded for drying and grinding. Steaming affects the strength of semihydrate. Disadvantages: total thermal treatment cycle is 8 hours, low performance</p>
10	<p>Production of high-impact gypsum with dehydration and drying in a single unit (using horizontal autoclave)</p>	<p>Ball mill (9), hopper (12), horizontal cylindrical autoclave (1), screen (2), steam line (4), heat carrier supply circuit (5), heater (6), condensate discharge pipe (7), fan (8), conveyor (10), disk feeder (11)</p>		<p>Advantages: combined dehydration and drying of material in the autoclave. Disadvantages: abrupt reduction (drop) of material temperature after releasing pressure in the unit upon completing dehydration. Cooling causes "secondary" dihydrate of calcium sulphate to form.</p>

11	<p>Production of high-impact gypsum with dehydration and drying in a single unit (using vertical autoclave)</p>	<p>Ball mill, hopper, dryer, cyclones, sleeve filters, elevators, feeders, crusher, screw conveyors, belt conveyors</p>	<p>Gypsum Plaster Production Scheme of the Samara Gypsum Plant and the Dekon Gypsum Plant</p>	<p>Advantages: production of high-impact high-quality material. Disadvantages: the size of the processed stone fragments does not exceed 50 mm, thus enlarging the stone specific surface and creating conditions for secondary dihydrate formation; if fines are present, the steamed gypsum might set in vertical autoclaves; stone drying in the autoclave is complicated since the material gets consolidated and its void space decreased.</p>
12	<p>Production of high-impact gypsum with self-steaming (applying external heating)</p>	<p>Hoppers, elevators, ball mill instead of pulverizer (11), jaw crusher, autoclave in clothing (4), furnace, jaw crusher (6), hammer crusher (9), pulverizer (11)</p>		<p>Advantages: production in units with external heating, autoclave mounted in the kiln, no external steam source is used for production of the binding material. Disadvantages: low performance of the line</p>
13	<p>Production of high-impact gypsum in liquid mediums (salt and acid solutions with water – magnesium sulphate)</p>	<p>Hopper (1), wet grinding ball mill (2), process solution tank (4), container (5), flushing container (11), dry grinding ball mill (13), hemihydrate gypsum hopper (14), disk feeder (2), pumps (6, 8), crystallizer with mixer used in the chemical industry, CONDENSER (9), filtration unit (10), drying (12)</p>		<p>Advantages: no formation of heterogeneous composition gypsum binding material is admitted. Disadvantages: dewatering and drying is performed in rotary filters or centrifuges – the material is not 100% dry</p>
High-Temperature Firing Gypsum Binding Materials				
No.	Technology	Description	Advantages and disadvantages	

14	Production of anhydride cement	The anhydride cement is produced by firing the gypsum raw material at 600...700°C, with consequent fine grinding of the fired material with additives stimulating setting and hardening. The basic stimulators are slaked lime or quicklime (2...5%), the basic blast-furnace slag (10...15%) or dolomite (3...8%) fired at (800...900°C). Other stimulators are various sulphates. E.g., sodium sulphate and bisulphate, blue and green vitriol, etc. If calcium sulfide is present in the anhydride, no use of sulphate compounds is recommended.	Advantages: no data. Disadvantages: no data
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15	Production of flooring plaster	Flooring plaster is produced by firing the gypsum raw material at $\geq 900^{\circ}\text{C}$. The gypsum is crushed in a jaw crusher, fired in a pit mill and ground in a ball mill.	Advantages: no data. Disadvantages: no data
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No Firing Gypsum Binding Materials

No.	Technology	Description	Advantages and disadvantages
16	Production of anhydrite binding material	The technology comprises four main operations: crushing to 20...30 mm fragments, drying at 170...180°C, grinding with stimulators in a ball mill, and storing for 2 months (max).	Advantages: no data. Disadvantages: no data
17	Production of no firing gypsum cement	Gypsum cement is produced by fine grinding in ball mills with addition of stimulating additives. In order to increase waterproofness, portland or slag-portland cement, basic granular or dump blast-furnace slags, cinder, crushed brick and dolomite dust are added. Adding only lime increases waterproofness, but deteriorates the cement strength considerably.	Advantages: no data. Disadvantages: no data

Waterproof (Composite) Gypsum Binding Materials (CGBM)

No.	Technology	Description	Advantages and disadvantages
18	Production of composite gypsum binding materials of low water requirement	Unlike GCPBM, the composite gypsum binding materials of low water requirement (CGBM) contain fine-dispersed portland cement and silica additives produced by combined activation with a plasticizer (superplasticizer) in a vibro- or ball mill. Two CGBM process layouts are available. The first one provides for preliminary combined grinding of portland cement with an active mineral additive of the required hydraulic activity and a superplasticizer followed by mixing of the produced hydraulic component with a gypsum binding material in a dry mix agitator. The other one is intended for increasing the initial grade strength of the CGBM.	Advantages: no data. Disadvantages: no data

Gypsum Cement Pozzolanic Binding Materials (GCPBM)

No.	Technology	Equipment produced by the Samara Strommashina Plant	Scheme	Advantages and disadvantages
19	<p align="center">Production of gypsum cement pozzolanic binding materials</p>	<p>Hopper, bucket belt elevator (6, 19), dryer (9), cyclones (10), ball mill (15), tripoli receiving bin (16), cement feed bin (18, 20), dry tripoli bin (21), plate feeder (2), jaw crusher (3), hammer crusher (4), belt conveyor (5), crushed gypsum bin (7), band feeder (8), fan (11), box-type feeder (17), cement and tripoli dispensers (22)</p>		<p>Advantages: applicable to gypsum or dry mix production completing the equipment for cement storing, dosing and feeding, and preparation of an active mineral additive, etc.</p> <p>Disadvantages: no data</p>