

هندسة عمليات انتاج الكبريت
**Engineering of Sulfur
Production processes**

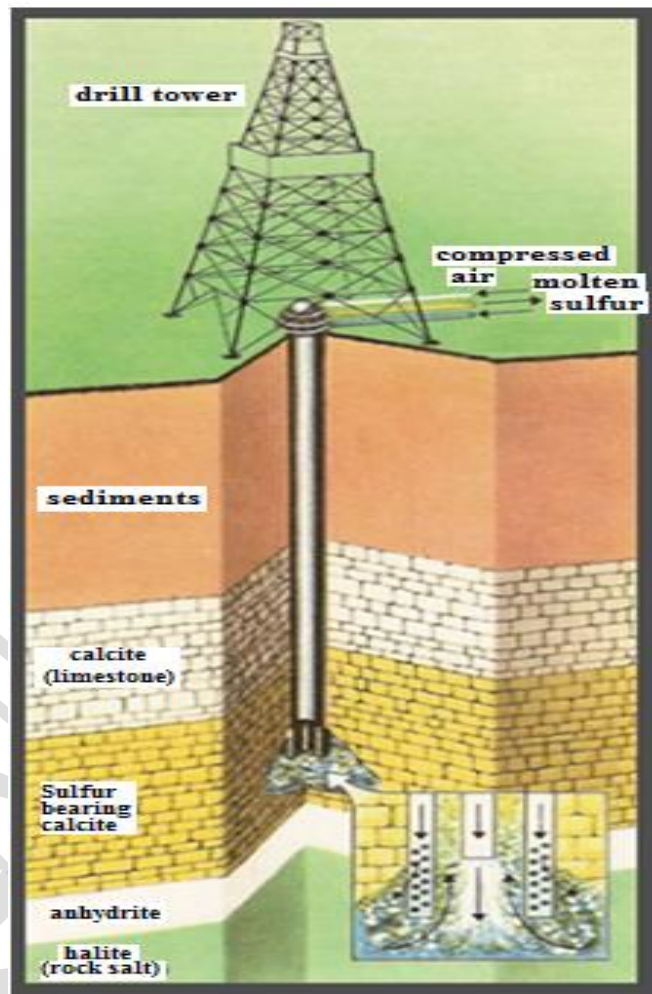
الصف الثالث هندسة التعدين

**Frasch mines processing
method**

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Frasch mines processing method

at bedded evaporate deposits were developed in a few other countries and on Mexican salt domes, **Iraq began** producing **Frasch sulfur** in **1972** at its **Mishraq Mine** with an **initial capacity of 250,000 metric tons per year (t/yr.)** that expanded to **1 Mt/yr** in **1974** (Merwin, 1974, Merwin and Keyes, 1976, p. 1249). The **Mishraq deposit possibly is the largest native sulfur deposit in the world**, with an estimated **100 to 250 Mt** of sulfur resulting from bacterial activity (Barker and others, 1979).



{Little is known about events in the Iraqi sulfur industry since 1990. Iraq's invasion of Kuwait in August 1990 precipitated the gulf war in 1991 during which United Nations (UN) forces bombed many of Iraq's industrial complexes. Although the sulfur operation was not damaged, sanctions imposed after the war curtailed exports of sulfur (Sulphur, 1991). The level of operation at Mishraq since then is not known, but an agreement that began in 2000 for Iraq to supply Jordan Phosphates Mines Co. with sulfur was believed to include sulfur produced at Mishraq. Jordan invoked an article of the UN charter that allows a UN member to not implement a sanction if it is against that country's domestic interests. The price of the Iraqi sulfur was discounted by about 30 percent from material available elsewhere in the region (Sulphur, 2000b)}.

Frasch process

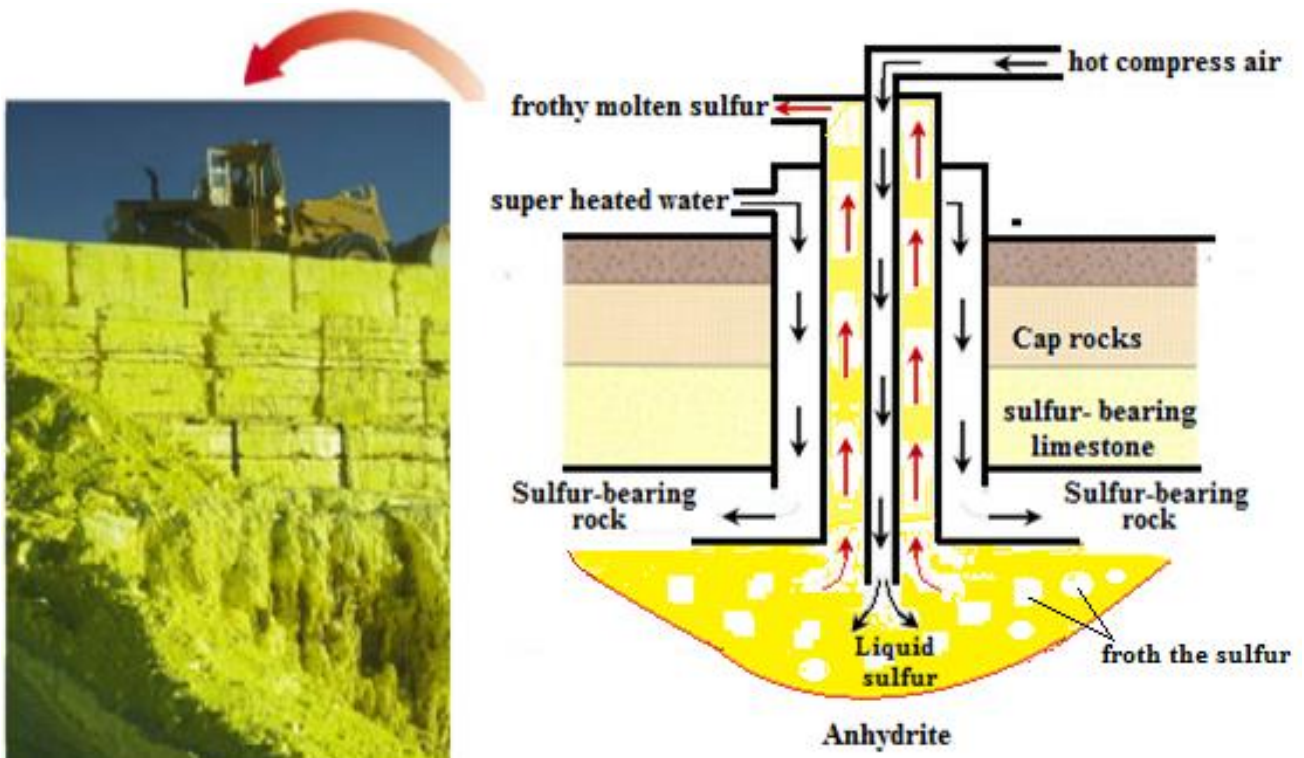
The **Frasch sulfur process** only works under very specific geologic conditions. It can be used for deposits **50–800 meters deep**. the process have proven to be either **salt domes** or bedded **evaporate deposits** in which permeable native sulfur deposits are enclosed in impermeable formations. The **elemental sulfur** obtained by this process can be very pure (**99.7 - 99.8%**). In this form, it is light yellow in color. If contaminated by organic compounds, it can be dark-colored

Frasch process

The **description** and **characteristics** of the **Frasch process** is as follows:

- 1- It can be used for deposits **50–800 meters deep**
- 2- the process was applied either on the **salt domes** or bedded **evaporate deposits**
- 3- A **hole** is drilled down to the **sulfur deposit** and in it is inserted a piece of apparatus consisting of **three concentric tubes**, see down schematic diagram.
- 4- **Superheated water** is injected directly into the **sulfur-containing mineral strata** (sulfur formation), during outermost tube, melting the **sulfur** all round it.
- 5- The temperature of **pumped water** at about **165°C** and under **sufficient pressure** to keep the water from boiling.
(**Because:** sulfur has a relatively low melting point (m.p.) at **115°C**, it is possible to melt it with **superheated water** which is water that has attained يتحقق من خلال a temperature above its boiling point **because** it is **under pressure**).
- 6- **3-38 cubic meters** of **superheated water** are required to produce every tone of sulfur depend on the **depth** and sulfur size.
- 7- the **elemental** Sulfur melts(m.p. **115 °C**) and **try to flows** into the middle tube.
- 8- **Water pressure** alone is unable to force the sulfur into the surface due to the molten sulfur's **greater density**.
- 9- **hot** compressed **air** pumped down through innermost tube (center) to froth the sulfur, making it **less dense**, and **pushing it** to the surface.
- 10- Early in the century, at the point in the process when the **sulfur reached** the surface, it was **pumped** into wooden forms or molds where it **cooled** and **solidified**.
- 11- Modern facilities use insulated pipes to **move the sulfur to heated storage tanks** where it is **held**.
- 12- At last the **heated storage sulfur transfer** to a terminal from which it is shipped to customers.
- 13- **when large quantities** of excess sulfur are **stockpiled**, the molten sulfur is cooled and solidified, **creating huge blocks** of solid sulfur from which the term “**poured صب to block**” is derived.
- 14- The **elemental sulfur** obtained by this process can be very pure (**99.7 - 99.8%**).

model of the Frasch process



The Frasch process

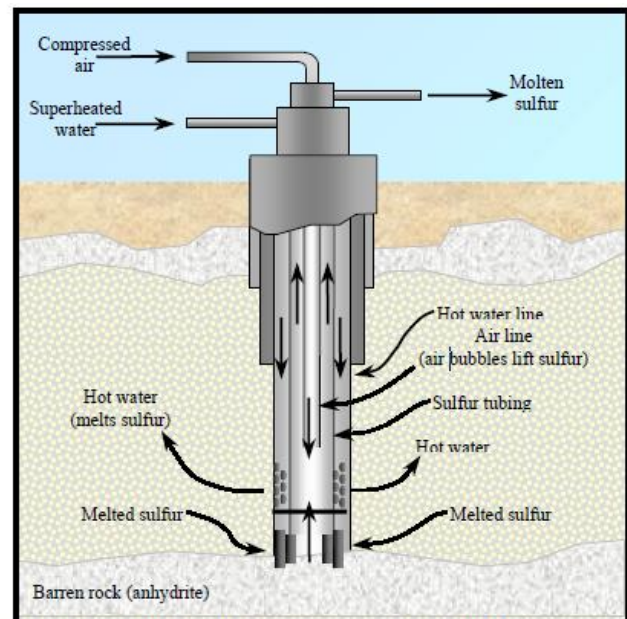
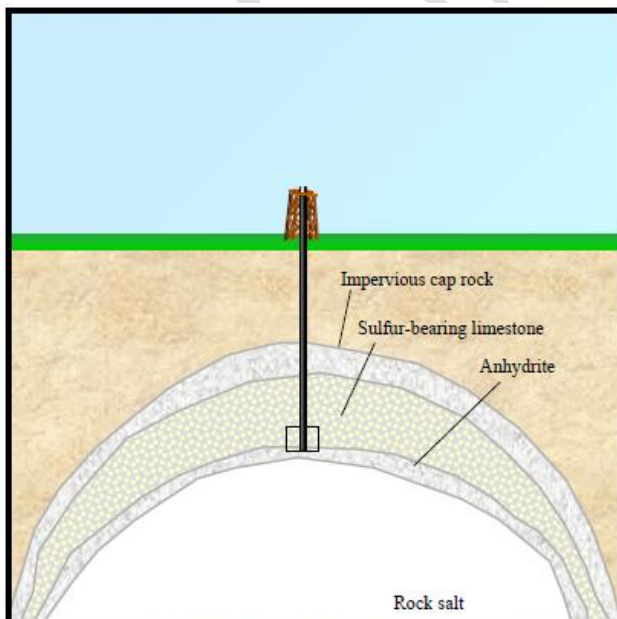


Illustration that shows the structure of a sulfur-containing salt dome and the details of the Frasch pump used to extract the sulfur from underground formations. Superheated water is pumped into the formation to melt the sulfur. The molten sulfur is lifted to the surface with compressed air.

