Separation of Potassium Magnesium Salts from Crude Mineral Salts by Electrostatic Methods—A New Concept

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ABSTRACT

An average 30 million tons of potash crude salts are being processed annually in the Federal Republic of Germany. Wet treatment methods as followed to date pose increasing environmental problems of disposal. Electrostatic separation methods were initiated by H. Autenrieth at the Potash Research Institute, Hannover, West Germany, though earlier work by M. J. E. Lawver of International Minerals & Chemicals Corporation, Chicago showed the initial feasibility. Autenrieth's work, in practical terms, opened new possibilities such as 1) methods of separation applicable to minerals with high percentages of water of crystallization, 2) methods that tolerate high dust content in the feed-stock and 3) use of a wide range of conditioning agents, 4) use of Electrostatic Tube Separators.

Singewald's report on the present state of the art of electrostatic separation in the German Potash Industry and installation of so-called electrostatic tube-separators offers itself as an alternative from the points of view of protection of the environment and of energy.

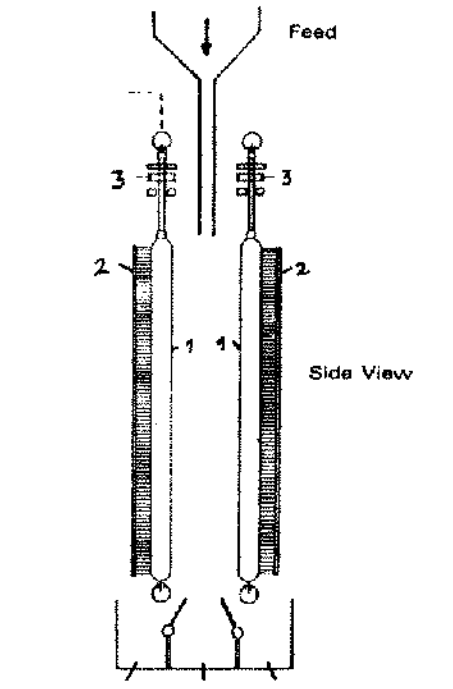
The treatment and concentration of potassium- and magnesium-containing crude salts in West Germany represents a major mineral dressing operation, with 30 million tons being processed on average per year. Wet treatment methods, which generate aqueous salt carrying effluents, pose increasing environmental problems of disposal, which become more and more expensive to solve. Dry, electrostatic treatment methods offer themselves as an advantageous alternative from the points of view of the protection of the environment, of energy conservation and of cost.

Pioneer research work and pilot-scale studies, which led to practicable industrial electrostatic separation methods, were initiated by H. Autenrieth (1957) at the Potash Research Institute, Hannover, in the German Federal Republic. Earlier work on electrostatic separation had been reported by M.J.E. Lawver (1951) of the International Minerals & Chemical Corporation, Chicago, USA, after the second World War. However, Lawver's work did not lead to an industrially viable production process. On the other hand, Autenrieth's work in Hannover enabled the German potash industry to install and operate successfully large-scale production units for magnesium and potassium salts, based on electrostatic separation methods, at a time when the world's chemical industries are fighting to conserve energy and to control pollution.

Lawver patented a process which claimed effective electrostatic separation after heat-treating the feedstock at 300–700°C, and then cooling it to 100–200°C. A production unit, based on this process, was built at Carlsbad, New Mexico, but its operation was discontinued after a time because of practical difficulties. By contrast, a number of large-scale separating plants based on the principles developed by Autenrieth have been built and are operating successfully in West Germany (Singewald, 1980). Autenrieth showed that after grinding potash minerals and treating them with specific inorganic and/or organic conditioning additives, an excellent electrostatic separation could be obtained at far below 100° (Autenrieth, 1957, 1959; Ullmann, 1977). Autenrieth (1969), in a paper on the Development of Electrostatic Separation of Potash Salts, reported details of the required pretreatment of the feed-stock, of the action of the conditioning agents, and of the electrostatic potentials required.

The research and findings opened new avenues, not only for the treatment of potash minerals, but of other minerals as well. In practical terms, these possibilities include:

1. Methods of separation, applicable to minerals with high percentages of water of crystallisation
2. Methods which tolerate high dust contents in the feedstock, without loss of efficiency (high dust contents are often unavoidable with the milling and grinding of certain minerals)



120 KV Free-fall Rotating-tube Separator with high throughput capacities by Autenrieth, H. and Dust, H. P. [6], [7].

1 : Rotating-tubes
2 : Brushes
3 : Drive

Figure 1.

3. The wide range of conditioning agents that have been described (Autenrieth, 1969) established the applicability of the electrostatic method for a number of difficult and complex minerals.

Singewald (1980) reported on the present state of art of electrostatic separation in the German potash industry. He ascribed the technical success of these installations not only to the preparation and separation principles, but also to the type of electrostatic separator that is being used, the so-called tube separator, which operates on the free-fall principle. While the previously used rotating drum separator was not suitable for the large throughputs required, the specifically developed tube separator is capable of handling the large tonnages involved (Figure 1). The design of this separator is based on a patent by H. Autenrieth and H. P. Dust (Autenrieth and Dust, 1960). A comprehensive report narrates an up-to-date process of the electrostatic separation of potash from mineral salts in consideration of all available publications (Bock, 1981).

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