A New Type of Countercurrent Column for the Zirconium-hafnium Separation

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The vibrating column, an apparatus which assures an intimate contact between two nonmiscible or very slightly miscible liquids circulating countercurrently, is especially useful for liquid-liquid extraction processes in a continuous system. Simple in construction and very efficient, as described below, it is an excellent instrument for laboratory-scale and pilot plant.

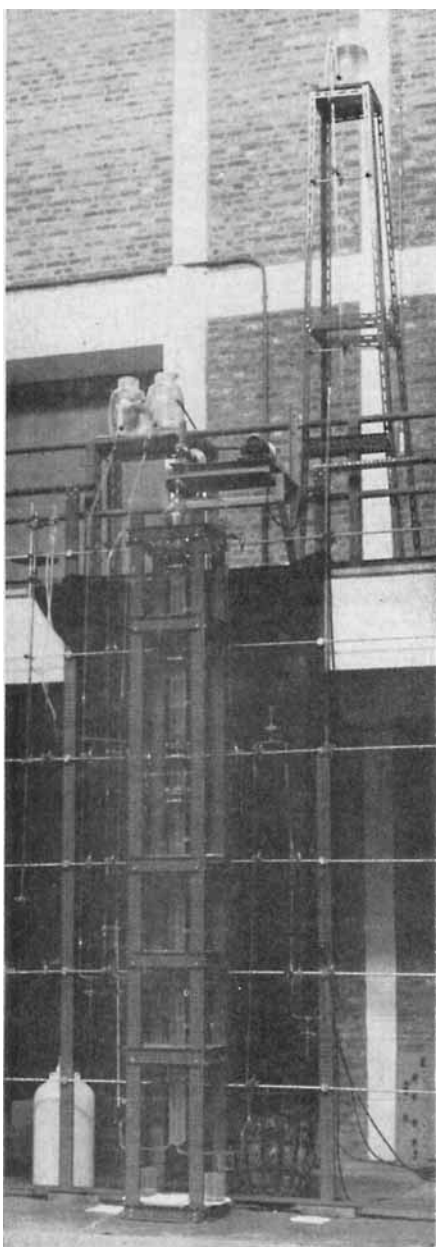

Fig. 1. Vibrating column.

As is well known, the primary requisite for efficient extraction is to realize the equilibrium state in the shortest possible plate height, which may be done by increasing the contact surface and the contact time between the two phases. The main problem in liquid-liquid extraction is to realize such a system while maintaining the countercurrent circulation.

Two interesting solutions have already been proposed: the pulse column (*1*) and the multistage column (*2*). The principal disadvantages of the pulse column are, first, the high price of pulse pumps or a pulsating system and, second, the limitations on the pulse frequency, which is the factor most favorable to good mixing. The multistage column is characterized by a complicated internal construction, as adequate mixing and separation require a very precisely disposed succession of baffles. This fact makes it a less suitable instrument to operate in a laboratory; moreover, the high number of baffles inside the column will exercise a resistance which will limit the total throughput.

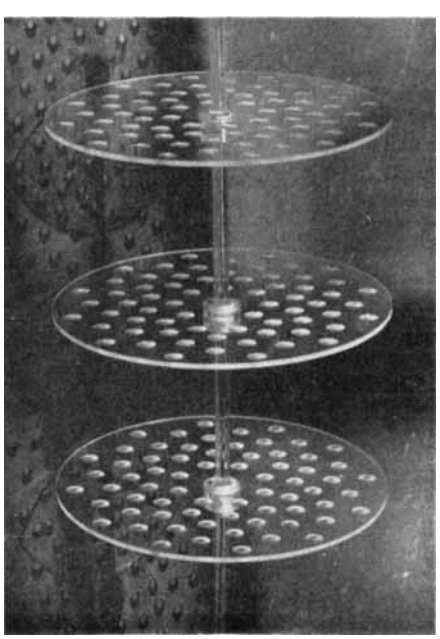

Fig. 2. Perforated plates.

The column that we are proposing consists of a simple cylindrical tube, in which moves a coaxial rod to which several perforated plates are securely attached (Figure 1). A simple electromagnetic device or a mechanical vibrating system makes this central rod vibrate at 3,000 cycles/min. with an amplitude of 1/25 in. The countercurrent liquid movement is assured through the holes of the plates and through the annular space between these plates and the wall of the column. The particular shape of the holes (semispherical chamfer) increases the contact time between the two phases at each plate level by creating a secondary local countercurrent (Figure 2).

A column of this type has been constructed to study the problem of zirconium-hafnium separation. The aqueous phase of the system contains zirconium-hafnium nitrates in nitric acid. The organic phase is a mixture of 60% TBP and 40% white spirit (specific gravity, 0.74; boiling point, between 140° and 160°C.). The average separation factor in this system is equal to roughly 13 (*3*).

The value obtained for 1 H.T.U. is 10 in. The experimental conditions are a Pyrex-glass column 2.4 in. in diameter, a Plexiglass rod, an amplitude frequency value of 120 in./min., and a flow rate of 10 liters/hr. for both phases.

Further details on the working of this column will be published later together with curves of H.T.U. against frequency and amplitude as well as curves of total throughput against the product of amplitude and frequency.

LITERATURE CITED

1. Van Dyck, W. J. D. U. S. Patent 2,011,186 (Feb. 16, 1934).
2. Fenske, M. R., and R. B. Long, U. S. Patent 2,667,407 (Jan. 26, 1954).
3. Hure, Jacques, and R. Saint-James-Schonberg, French Patent, provisional number 665,494 (March 17, 1954).