An Improved Continuous Extractor for Liquids

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Prolonged heating of the extracted substances which occurs in many types of continuous extractor is a great disadvantage if any of the substances to be extracted are sensitive to heat. If, however, the extract can be removed and concentrated, losses caused by heating can be considerably reduced while the advantages of continuous extraction are retained.

In the apparatus here described this is achieved by passing the extract through a climbing-film evaporator where it is concentrated (in less than 1 sec.) and separated from the vapour in a cyclone. The solvent vapour is condensed and returned to the system to complete the cycle. A reservoir of fresh solvent is included to make up the volume as the concentrate is removed.

APPARATUS

Fig. 1 shows the general arrangement of the apparatus when used with solvents lighter than water. The condensed solvent vapour from the evaporator runs into the inner of two concentric cups in the control head *A*, the solvent flow for the extraction being controlled by the tap *B*, any excess overflowing into the 2 l. reservoir *E*. The solvent is then distributed in the 5 l. extractor *D* by the hollow turbine stirrer *C* as fine globules which rise to the surface to overflow into the reservoir *E*. By adjustment of the height of the reservoir and the tap *F*, the plug of which is cut to permit graduated opening, the mixed extract and excess solvent are led into the climbing-film evaporator *G* at a suitable rate. The evaporator consists of three parallel 36×0.25 in. tubes, constricted to 0.06 in. over a length of 0.5 in. at the bottom to prevent excessive surging. It is heated by a steam jacket. The extract is flash evaporated and the resulting spray passes tangentially into a cyclone *H* (made from a 500 ml. bolt-head flask) through a tube of cross-section area equal to the sum of the areas of the evaporator tubes. The centrifugal effect separates the concentrate from the vapour which is led out from the top of the cyclone to be condensed and so complete the cycle. The concentrate flows out from the bottom of the cyclone and is cooled and collected in the receiver.

The apparatus can readily be adapted to deal with solvents heavier than water.

Fig. 1. Apparatus for extraction and concentration (not to scale). *A*, Control head; *B*, tap; *C*, hollow turbine stirrer; *D*, extractor; *E*, reservoir; *F*, tap; *G*, climbing-film evaporator; *H*, cyclone.

EXPERIMENTAL

0.02% (w/v) Bromothymol blue solution (4.5 l.) in dil. HCl was placed in the extractor and 2 l. of benzene in the reservoir. The steam and water were turned on and the control tap *F* adjusted. A maximum distillation rate of 68 ml./min. was

obtained and the corresponding rate for the concentrate was 1.25 ml./min. giving a ratio of 54.3:1 and an estimated extraction time of 26.7 hr. before refilling of the reservoir becomes necessary.

When repeated with 4.57 l. of urine at pH 1.0 the extraction of 11-dehydro-17-hydroxycorticosterone and 17-hydroxycorticosterone was complete in the first period of

8 hr. as checked by chromatography (Zaffaroni, Burton & Keutmann, 1950).

SUMMARY

An apparatus is described for the extraction and concentration of heat-sensitive compounds.

REFERENCE

- Zaffaroni, A., Burton, R. B. & Keutmann, E. H. (1950). *Science*, 111, 6.