

### ***Analysis of Effectiveness of PVC Thermal Stabilizing Agents by Conductometric Method***

Decreasing in the dehydrochlorination rate as well as decrease in the rate of catalytic cleavage of macromolecule by such agents as HCl, —O—O—, and R· were observed when thermal stabilizing agents for PVC were used. On the other hand, the formation of chromophore groups with more than four conjugated double bonds has not been observed.

The mechanism of action of stabilizers is different, but all of them participate in the process of hydrogen chloride acceptance. The possibility of HCl acceptance is not the one exponent of the quality of a stabilizing agent. Therefore, the rate of reaction with HCl and influence of products of this reaction on the degradation kinetics must be taken into account.

The principles of choice of thermal stabilizing agents, from the viewpoint of their effectiveness,<sup>1,2</sup> are related to the examination of determined compositions of PVC with stabilizers, plasticizers, etc.

Such investigative methods led to determination of all above-mentioned elements concerning the quality of stabilizers. The separation of individual components determining the participation of stabilizers in degradation processes are the important subject in this paper.

The amount of hydrogen chloride accepted by stabilizer one can be determined by acidimetric, nephelometric, potentiometric, and conductometric methods. Because of the high accuracy, the last method was adopted in this paper.

Papers concerning the analytic methods have pointed out that when stabilizers were titrated with alcoholic solutions of hydrogen chloride, the necessity of using small volumes of concentrated solution of titrants may be omitted without decreasing the accuracy, because the conductivity of the solution of stabilizer and of products of their reaction with HCl is lower than the conductivity of titrant solutions.

On the basis of these results, the following way for analysis was adopted. An aliquot of stabilizer, 0.2–0.5 g weighed with analytical accuracy, should be dissolved in 50 cc of C<sub>2</sub>–C<sub>4</sub> alcohol; 0.05N HCl in C<sub>2</sub>–C<sub>4</sub> alcohol must be used as titrant. After addition of each portion of titrant, the conductivity increases at first and then decreases to constant value. Then the next portion of titrant is added. To shorten the time of analysis, the bigger quantity of titrant may be added (10–2 cc) at first. But near the neutral point, which can be noticed when conductivity increases after the fresh portion of titrant is given, titrant must be limited to 0.1–0.2 cc. Analysis is finished after addition of 3–4 portions of 1-cc volumes above the equivalent point.

The obtained amounts are plotted as a function of conductivity increment on the unit of volume versus volume, and the equivalent amount of titrant will be read. The amount of accepted hydrogen chloride  $M$  in mg HCl per g of stabilizer is determined from the equation

$$M = 36.5 \times \frac{N \cdot V}{G}$$

where  $N$  = titer of solution (gram-equivalent/dm<sup>3</sup>),

$V$  = volume of titrant (ccm), and  $G$  = aliquot (g).

The above-described method leads to the selective determination of one of basic factors concerning to the effectiveness of stabilizer action. The methods of investigations of influence of products of reaction HCl stabilizer on the dehydrochlorination kinetics is well known,<sup>1,2</sup> and therefore only the method of determination of stabilizer reactivity should be elaborated for the interpretation of their action.

The conductometric titration of thermal stabilizers is a useful analytical method for the estimation of individual parts of stabilizers used in conversion factories. At the present, the method of refraction measurement is frequently used,<sup>3</sup> but the results obtained are not always correct. Stabilizer, for example, which is the mixture of organotin compound with epoxidized soybean oil and with plasticizer, has the refractive index characteristic for a mixture of very different weight compositions.

Except for the above-mentioned possibility of using the method, it can be applied to the investigation of durability of stabilizers on the action of energetic and chemical factors.

#### References

1. K. S. Minsker and L. D. Bubis, *Vysokomol. Soedin.* **9**, 52 (1967).
2. K. S. Minsker and T. B. Zavarova, *Plast. Massy*, **9**, 56 (1966).
3. Deutsche Advance Produktion G.m.b.h., *Stabilizatoren*,

JERZY WYPYCH

Central Laboratory for Technical Products,  
Chemistry Department,  
Lodz, Poland

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