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**INSENSITIVITY OF THE FLAME
IONIZATION DETECTOR TO FORMIC ACID**

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INSENSITIVITY OF THE FLAME IONIZATION DETECTOR TO FORMIC ACID

A statement which is made in the advertising material of vendors involved in the sale of gas chromatographs using flame ionization detectors is that these detectors are "sensitive to all organic compounds" (6). There is one very important exception to this statement. Perhaps by pointing out this exception some work can be stimulated to develop a technique to analyze aqueous solutions of formic acid by gas chromatography.

Attempts to separate quantitatively small amounts of formic acid from water on gas chromatographic columns were unsuccessful. The use of the flame ionization detector was considered because its detector would give no response for water. Unfortunately, we found that the flame detector also gave no response for formic acid (5). At about this same time McWilliam published the same observation (2). This lack of response could have been predicted from an empirical relationship offered by Onkiehong in 1960 (3). Onkiehong offered an expression which gave an excellent correlation between flame ionization detector response and the concentration of the various components:

$$\text{C-factor} = \frac{\text{Molecular Weight}}{\text{number of carbon atoms} \times 12}$$

Multiplication of the observed peak area by the corresponding C-factor and normalization of the corrected areas gives a good correlation between detector response and weight percent composition. For oxygen-containing compounds, however, Onkiehong

found that the empirical expression had to be modified:

$$\text{C-factor} = \frac{\text{Molecular Weight}}{12(\text{No. carbon atoms} - \text{No. carbons attached to oxygen})}$$

This empirical relation now could be used for esters, alcohols and ethers, all of which gave considerably reduced responses when compared to their corresponding hydrocarbons.

Acids seemed to give a more pronounced diminution of detector response than alcohols, esters, or ethers. The trend is the same, i.e. the smaller the difference between the number of carbon atoms, and the number of carbons attached to oxygen, the larger the necessary correction factor. The implication is that for formic acid, in which all carbon atoms are bonded to oxygen, the response would be (at least) severely diminished. The empirical expression becomes an indeterminant. Actually, no response was found by McWilliam (2) or by Seed (5). It is interesting to note that two of the latest text books on gas chromatography mention those compounds to which the flame ionization detector is insensitive, but formic acid is missing from their lists (1, 4).

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