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Activity Index of Urea-formaldehyde compounds and moulding powder *

by

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Synopsis: The Urea-formaldehyde products exhibit distinctly different patterns of nitrogen availability involving low initial and more uniform response than the standard source of nitrogen. The overall efficiency of properly formulated urea-form product equals or exceeds that of conventional nitrogen fertilizers in respect of long season crops such as turf. The single application of urea-form may be made at higher levels than would be feasible with more soluble nitrogen sources.

Introduction: Clark *et al* (1956) described urea-formaldehyde products as mixtures of polymethylene ureas which exhibits urea-formaldehyde mole ratio of greater than unity. Their nitrogen contents are variable, have low solubility in water and organic solvents and lower rates of nitrification in soil media than the soluble forms of chemical nitrogen fertilizers. Yee *et al* (1946) found that the nitrification rates, surface areas and solubilities of urea-formaldehyde products investigated increased with an increase in urea-formaldehyde mole ratio of the products. Chemical data collected by Armiger *et al* (1948) indicate that the rate at which the nitrogen contents of such materials is converted to nitrate form in soil media increases with the mole ratio and solubility index. The solubility index was determined by digesting 1 gm of sample in 400 ml of water for 24 hours at 30° C. Significant correlations were obtained by Clark *et al* (1948) between the primary nitrogen solubility data and nitrogen of urea-formaldehyde samples nitrified on incubation in soil for 3 weeks. Clark *et al* determined secondary solubility by digesting the residue with five times as much water but otherwise under similar conditions. Significant correlations were obtained between secondary solubility and the nitrogen content of the sample nitrified after first three weeks. In A. O. A. C. (1955) another procedure has been suggested in the place of solubility index which is called as Activity Index. This procedure consists in estimating the water insoluble nitrogen and the hot water insoluble nitrogen. By applying the following equations:

$$\text{Activity Index} = \frac{(\text{W. I. N.} - \text{H. W. I. N}) \times 100}{\text{W. I. N.}}$$

W. I. N. = Water insoluble nitrogen

H. W. I. N. = Hot water insoluble nitrogen

The H. W. I. N. was determined by taking the urea-formaldehyde product equivalent to 0·3000 ± 0·005 gm of W. I. N. and heating it for one hour with 250 ml of buffer phosphate solution. The nitrogen was estimated in the insoluble material left as residue. Total N content of the U. F. products was determined by Kjeldahl procedure.

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Materials and Methods: A number of urea-formaldehyde products were prepared in the laboratory and their activity indices were compared with U. F. fertilisers obtained from foreign countries.

TABLE 1.

U. F. products employed for activity index determination.

S. No.	Fertiliser.
1. UF. D.	Prepared in the laboratory.
2. UF. E.	
3. UF. F.	
4.	Uramite American product
5.	UF. moulding powder (Imported by one Plastic Co.)
6.	UF. (15) Japanese product

(1) Procedure for the preparation of UF products in the laboratory was adopted from the work of Clark *et al* (1948).

(2) Activity index of the urea-formaldehyde compounds was determined by the procedure given by A. O. A. C. (1955).

Results and Discussion:

TABLE 2.

Characteristics of Urea-formaldehyde products.

S. No.	Fertiliser	U/F mole ratio	Total N%	Activity index.
1.	UF. D.	1·68	37·52	23·70
2.	UF. E.	1·32	35·00	22·50
3.	UF. F.	1·12	34·02	12·93
4.	Uramite	—	37·62	42·77
5.	UF. moulding powder	—	19·48	83·00
6.	UF (15)	—	38·60	33·64

The activity index of UF. products decreases with the decrease in the mole ratio. As shown by data, the activity index of UF. moulding powder is higher than all the other products. This moulding powder could not be used for moulding of plastic articles as some chemical change had taken place during storage. As compared with other products, it has low N content which is due to low U/F mole ratio as well as filler material (paper pulp.). But the efficiency of moulding powder was found to be equal to that of standard fertiliser ammonium sulphate and urea.

The Activity Index of UF products prepared in the laboratory indicated that as the UF mole ratio decreases the activity index also decreases. But the high activity index of moulding powder proves that even if the mole ratio of the

product is less than unity, even then, the availability of nitrogen is high. This product was compared with ammonium sulphate and urea in nitrification and crop growth tests.

The following table indicates the percentage nitrification and total yield of rice crop in pot culture experiments.

TABLE 3.

Percentage nitrification and total yield of rice crop (N applied at 100 lb/acre.)

S. No.	Fertiliser	Percentage nitrification	Total yield in gm. (Average of 4 replications)
1.	Control	—	14·00
2.	UF. moulding powder	67·20	33·20
3.	Urea	94·00	33·50
4.	$(NH_4)_2 SO_4$	81·33	31·62

Thus both the nitrification value and the yield data indicate that the efficiency of UF moulding powder compares formally with that of standard fertilisers. Urea-formaldehyde moulding materials are prepared in two stages. In the first stage, the reaction between urea and formaldehyde is carried out at low temperature as a result of which complex molecules which are resistant to nitrification are not formed. Even the soluble nitrogen of these materials prepared under such conditions is not very low. In the second stage, a filler material such as paper pulp is added and the moulding powder so formed is given heat treatment in moulds when the articles are manufactured. The UF. moulding powder used in this work was not given any heat treatment. The high activity index and availability of nitrogen indicates that even though the U/F mole ratio may be less than one, even then the UF fertilisers of high efficiency are obtained.

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