

## Oxidative Cleavage of Nitrilotriacetic Acid to Iminodiacetic Acid

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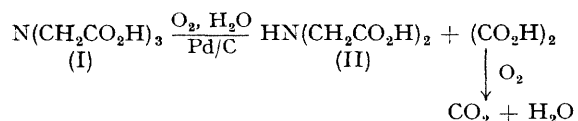
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**Summary** The oxygenation of nitrilotriacetic acid solution at pH 8.5 and 90° in the presence of 5% Pd/C gives almost quantitative yields of iminodiacetic acid.

detected and small amounts of oxalic acid could be isolated as sodium oxalate. These data support the following scheme:

NITRILOTRIACETIC ACID (I) is a possible replacement for phosphates in detergents, therefore, a knowledge of its decomposition products under oxidizing conditions is important. Cerium(IV) salts have been reported<sup>1</sup> to produce  $\text{NHMe}_2$  and  $\text{CO}_2$ , while biodegradation led to  $\text{CO}_2$ ,  $\text{H}_2\text{O}$ , and  $\text{N}_2$ .<sup>2</sup>

We have now found that the oxygenation of an aqueous solution of (I) in the presence of 5% Pd/C at pH 8.5 (90° for 10 h) formed  $\text{CO}_2$ † and iminodiacetic acid‡ (II) almost quantitatively.§ Although we used  $\text{O}_2$  gas, related work indicates that this reaction will also occur under these conditions using air at atmospheric pressure. No CO was



In the absence of catalyst under the same conditions, (I) was recovered unchanged. The only precedent for selective fragmentation is the reported hydrolytic cleavage of (I) with sulphuric acid at 130–135°<sup>3</sup> and with hydrochloric acid at 190–200°<sup>4</sup> to give iminodiacetic acid and glycollic acid.

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† CO and  $\text{CO}_2$  detection was by Fisher Gas Partitioner.

‡ I.r., n.m.r., m.s., and t.l.c. data were all in agreement with those of an authentic sample of iminodiacetic acid.

§ A 92.5% yield of monoammonium iminodiacetate was obtained by absorbing the filtered reaction solution on an acid resin (Rexyn 101H R-203 Fisher) and eluting with 1:1  $\text{NH}_4\text{OH}$ .

<sup>1</sup> H. Holzapfel and K. Dittrich, *Talanta*, **1966**, **13**, 309.

<sup>2</sup> J. B. Thompson and J. R. Duthie, *J. Water Pollut. Contr. Fed.*, **1968**, **40**, 306.

<sup>3</sup> W. Kozak and Z. Debowski, *Zeszyty Nauk. Politech. Slask. Chem.*, **1963**, **16**, 47.

<sup>4</sup> W. Heintz, *Annalen*, **1869**, **149**, 88.