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'Clean burning' propellants: A commentary

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"CLEAN BURNING" PROPELLANTS

A commentary

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Pesce-Rodriguez, Fifer and Heimerl¹ have studied the influence of some substances on the formation of nitrogen oxides from the combustion of propellants. They report that urea incorporated in solid propellants decreases the formation of nitrogen oxides and decreases the flame temperature. They assert that the urea is compatible with nitrocellulose-propellants. No reference beside the experimental results reported are given for this statement of compatibility.

The experimental methods used are gas chromatography with a heating rate of 10 °C/min, pyrolysis of 0.6 mg samples at 1000 °C and differential scanning calorimetry with a heating rate of 10 °C/min. These methods under the experimental conditions given, small quantities, very fast heating rates, are inadequate for compatibility studies. Reactions occurring under storage conditions can not be detected.

Weight loss studies² with urea and nitrocellulose showed, that urea catalyses the decomposition of nitrocellulose. Urea was incorporated in nitrocellulose with acetone solution. Samples of 1 g of dried mixtures containing ca. 1 and 5 weight-% urea were heated at 95 °C according to the standardized FOA method³ and the weight loss was determined at regular intervals. Results are shown in Figure 1. With the lower urea concentration there is a short induction period but the higher concentration gives an instantaneously observable accelerated decomposition. Similar results were obtained with e.g. oxamide.

It may be noted that a continental propellant factory tried to manufacture a propellant with urea but the batch self-ignited during the production.

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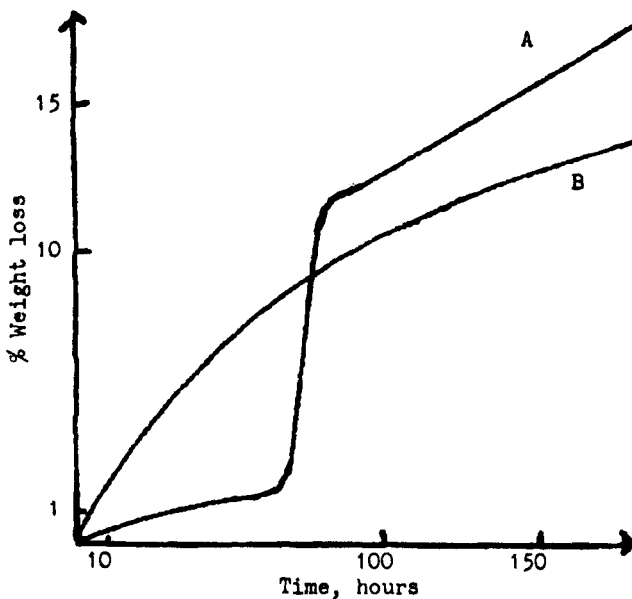


FIGURE 1. Weight loss curves at 95 °C for nitrocellulose with 1.0 % urea (A) and 5.2 % (B).

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