

This article was downloaded by:

On: 29 January 2011

Access details: *Access Details: Free Access*

Publisher *Taylor & Francis*

Informa Ltd Registered in England and Wales Registered Number: 1072954 Registered office: Mortimer House, 37-41 Mortimer Street, London W1T 3JH, UK



## Phosphorus, Sulfur, and Silicon and the Related Elements

Publication details, including instructions for authors and subscription information:

<http://www.informaworld.com/smpp/title~content=t713618290>

## Synthesis and Tribofragmentation of Monothio-Phosphates

H. Zinke<sup>a</sup>; R. Schumacher<sup>b</sup>

<sup>a</sup> Ciba-Geigy Marienberg GmbH, Bensheim, FRG <sup>b</sup> CIBA-GEIGY AG, Werk Fribourg/Marly, Forschungszentrum KA, Fribourg, Switzerland

**To cite this Article** Zinke, H. and Schumacher, R.(1990) 'Synthesis and Tribofragmentation of Monothio-Phosphates', Phosphorus, Sulfur, and Silicon and the Related Elements, 51: 1, 365

**To link to this Article:** DOI: 10.1080/10426509008040894

**URL:** <http://dx.doi.org/10.1080/10426509008040894>

PLEASE SCROLL DOWN FOR ARTICLE

Full terms and conditions of use: <http://www.informaworld.com/terms-and-conditions-of-access.pdf>

This article may be used for research, teaching and private study purposes. Any substantial or systematic reproduction, re-distribution, re-selling, loan or sub-licensing, systematic supply or distribution in any form to anyone is expressly forbidden.

The publisher does not give any warranty express or implied or make any representation that the contents will be complete or accurate or up to date. The accuracy of any instructions, formulae and drug doses should be independently verified with primary sources. The publisher shall not be liable for any loss, actions, claims, proceedings, demand or costs or damages whatsoever or howsoever caused arising directly or indirectly in connection with or arising out of the use of this material.

## SYNTHESIS AND TRIBOFRAGMENTATION OF MONOTHIO- PHOSPHATES

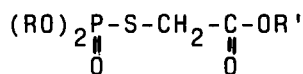
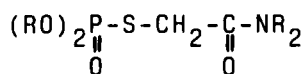
H. ZINKE and R. SCHUMACHER<sup>a</sup>

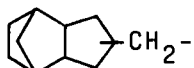
CIBA-GEIGY Marienberg GmbH, Postfach, D-6140  
 Bensheim 1, FRG

<sup>a</sup>CIBA-GEIGY AG, Werk Fribourg/Marly, Forschungszentrum  
 KA, CH-1701 Fribourg, Switzerland

Besides the well-known zinc dithiophosphates (ZDTP) phosphorus and sulfur containing ashless additives are used to improve the lubrication properties of modern engine and hydraulic oils. It is generally accepted that a wear reducing reaction layer is formed by additive tribofragmentation reactions in the friction zone of the metal surface. The composition of those reaction layers and the formation mechanism relative to the used additive is quite unknown. By systematic modification of monothiophosphates the influence of molecule parameters on the wear reducing properties were investigated (1).

By reaction of ammonia-0,0-diisopropylmonothiophosphate with different monochloroacetic acid derivatives the corresponding substituted monothiophosphates were formed (2).



$R$ :  $iC_3H_7$ -;  $R'$ :  $i-C_4H_9$ -,  $nC_6H_{13}$ -,  $C_{13/15}H_{27/31}$ -, 

The wear reducing properties of the monothiophosphates were investigated with the SRV-apparatus at the same phosphorus level.

Surface analysis of the wear area by AES shows that by tribofragmentation of the additives phosphorus and sulfur enriched reaction layers are formed which break down at higher temperature if insufficient phosphorus reacts with the metal surface.

- (1) R. Schumacher, D. Landolt, H. J. Mathieu, H. Zinke, "Surface Reaction Behaviour of Isogeometrical Phosphorus Compounds", ASLE Trans. 26 (1982) 94 - 101.
- (2) EP 0125209 (A2) 3.5.1984, CIBA-GEIGY AG, CH-4002 Basel, Inv. H. Zinke, R. Schumacher.