## 7.3 Possibilities of Combining Zeolite A with Different Co-builders

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The use of phosphates in laundry detergents has been increasingly criticized since the end of the 1960s because of their linkage to the overfertilization of stagnant and slowly flowing surface waters, which eventually has caused eutrophication of rivers and lakes. Induced by legislative regulations or voluntary agreements, this led to significant reductions of the phosphate content of laundry detergents and even to phosphate bans in some U.S. states, in Japan, and in some countries of Western Europe. Because of the ideal detergency properties of phosphate it was not accepted for a long period that phosphate could be either partially or wholly replaced as a laundry detergent ingredient. Developments in recent years have shown that low-phosphate and even nonphosphate detergents with suitable phosphate substitutes can meet consumer needs. A major part in this development has been played by Zeolite A. This phosphate substitute is environmentally compatible and has been used in many laundry detergents worldwide. By carefully combining Zeolite A with certain sequestrants (co-builders) and accompanying adaption of the surfactant portion, low-phosphate and phosphate-free detergent formulations have been developed that have detergency performance characteristics comparable with former high-phosphate laundry products. By adding water-soluble co-builders with a carrier and threshold effect, the detergency performance of zeolite-built laundry detergents can be enhanced with regard to soil removal and prevention of soil redeposition and salt deposits on textiles, preferable under European washing conditions. The question as to the extent to which phosphates will be supplanted by Zeolite A, partially or completely, depends not only on legislative regulations but also on consumer acceptance of these laundry detergents and on the development of market prices for phosphates and Zeolite A.

## 7.4 Mixed Builders: Comparison of the New Builder Systems for Laundry Detergents

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The main generally recognized builder requirements for the optimization of laundry detergent performance can be summarized as good performance, lack of toxicity toward man and the environment, and low cost. Sodium tripolyphosphate (STPP) became one of the major constituents of laundry detergents because it was the product satisfying these criteria best. The important role played by polyphosphates in the cleaning process and the desire to reduce the problems of eutrophication led to the search for alternative builders. This paper discusses the performance of mixed builder systems (including STPP) in detergency, in terms of functional effectiveness as well as on a cost/performance basis. STPP still provides the best answer to the three requirements mentioned above. Considering only performance, NTA might be an acceptable alternative. On the same basis zeolite cannot be considered a complete builder. On a cost/performance basis, the mixed builder systems—and more particularly the free phosphate systems—do not appear to be advantageous alternatives for the consumer. Moreover, from the ecotoxicological point of view, some candidates for the replacement of polyphosphates are not without problems.

## 7.5 Builders for Heavy-Duty Liquids

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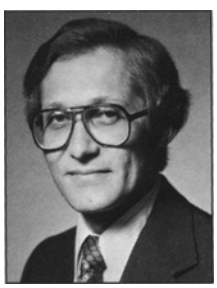
This paper discusses the need for and the use of builders in heavy-duty liquids in Europe and North America. Phosphate usage and restrictions and the development of nonphosphate substitutes such as NTA, citrates and others are presented. Problems and solutions to overcome incompatibilities involving appropriate use of hydrotropes/coupling agents, viscosity control and specific gravity adjustment are discussed. Comments on European and North American formulations as they relate to these problems and solutions are made. The state of the art of builders in heavy-duty liquid formulations is presented and potential developments and trends in the 1990s are discussed.

## 7.6 Builder Trends in North American Detergent Products



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The type and amount of detergent builders used in North American laundry detergent products have changed dramatically during the past 20 years. From the introduction of built detergents in the 1940s until the late 1960s, sodium tripolyphosphate dominated the builder market. Since that time a wide variety of environmental,