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On the effect of price policies in the design of formulated products

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Highlights

Formulated product design depends on the ingredient prices
Chemical prices are agreed between companies in contracts
An extended pooling problem includes process, environmental and price constraints
Single year and multiyear contracts are evaluated
The contract type is ingredient dependent but robust with the environmental burden.

Abstract

In this work an extended pooling problem is formulated to select the optimal price policy for the ingredients of a formulated product such as a detergent. Various contracts for obtaining discounts as a function of the amount purchased are considered including fixed discount, linear, logit, a discount beyond a certain amount purchased and constant elasticity. The feature is that while certain ingredients are used in large amounts, others represent only a small fraction of the product. The problem becomes an MINLP that it is solved for the optimal product formulation selecting the contract on a year and on a multiperiod basis. Various mathematical reformulations are proposed. The results show the selection of the contract is ingredient dependent but it is quite robust with the environmental burden. However, this decision can change when actual contract conditions on the limiting amounts for the discount are provided to the model.

Key words: Mathematical optimization, formulae performance, product and process design, price policies; pooling problem