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Original Research Paper

Investigation on resistance to attrition of coated particles by response surface methodology

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ABSTRACT

The purpose of the present study is to obtain better understanding of the influence of the coating thickness, *h*, coating formulation, T_g, and fluid bed temperature, T_{bed}, variables on the resistance to attrition of the coated sodium benzoate reference particles. Three reference coating materials (T_g = 50 – 125 – 150 °C) have been sprayed by using top spray fluid bed coater. Per each coating formulation three different coating levels (*h* = 1% – 5% – 9% w/w) have been obtained. The coating processes were performed at three different fluid bed temperatures (T_{bed} = 40 – 55 – 70 °C). The experiments have been designed according to the response surface methodology (RSM). Both single effects and interactions between single effects on the resistance to attrition (response variable) calculated by means of repeated impact tester were evaluated. From statistical analysis, the coating quantity appears to have a predominant effect on the resistance to attrition of the coated particle in these studied ranges of variables. This relationship is linear and positive, which means that an increasing quantity leads to more resistance to attrition. The interaction coating thickness – coating formulation, the interaction between the fluid bed temperature and the coating formulation and the coating formulation as well as the interaction costing thickness – fluid bed temperature were found to be very significant. On the contrary, no direct effect of the fluid bed temperature on the resistance to attrition is detected.

1. Introduction

Nowadays agglomerates, granules, tablets, pellets and nonpareil seeds are often coated so as to improve its functionality and enhance its application. Possible reasons for applying coating are as follows [1–3]:

- Shelf life enhancement and prolongation;
- To achieve controlled, sustained, delayed and/or targeted drug delivery release properties [4,5], for chemical or physical protection of sensitive ingredients [6];
- Improve process ability and physical properties such as solubility, dispersibility, hygroscopicity and stability [7,8];
- Facilitate dosage and mixing: size, shape or surface texture;
- Masking taste and smell of the product [9];
- Aesthetic improvements and recognisability like colour and company logo;
- Avoid caking during storage;
- Increase strength of the product to prevent dust formation;
- Enhance the overall quality of food and pharmaceutical ingredients [10–13].

It is of high importance to be ensured that the coatings can resist the mechanical stresses imposed on them during production, transportation and handling. Therefore the strength of the coatings plays an important role. When a coating is applied on agglomerate it should be strong enough to survive subsequent processing and handling. If a coating fails under stress, it leads to a dramatic change in the properties of the product.

Aqueous film-coating is a process commonly employed in the food and pharmaceutical industries. Microencapsulation is a very popular method for the preparation of coated particles and, in general, for controlled release systems. Fluidised bed coating knows several applications in food-processing such as microencapsulation of flavours, micro-organisms and enzymes for the preparation of bread or cheese. The fluid bed coating can be divided into three different process-steps: fluidisation, atomisation and drying. The variables can be process (Table 1) or product (Table 2) related. A continuous film is formed after several cycles of wetting and

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