Advanced Powder Technology 23 (2012) 40–45

Contents lists available at ScienceDirect

Advanced Powder Technology

journal homepage: www.elsevier.com/locate/apt

Original Research Paper

Optimization and characterization of direct coating for ibuprofen particles using a composite fluidized bed

Nobuo Miyadai [a,b,*], Kenjirou Higashi [a], Kunikazu Moribe [a], Keiji Yamamoto [a]

[a] Graduate School of Pharmaceutical Sciences, Chiba University, 1-8-1 Inohana, Chuo-ku, Chiba 260-8675, Japan
[b] Narita CHC Research Center, SSP Co. Ltd., 1143 Nanpeidai, Narita, Chiba 286-8511, Japan

ARTICLE INFO

Article history:
Received 6 September 2010
Received in revised form 16 November 2010
Accepted 7 December 2010
Available online 18 December 2010

Keywords:
Direct coating
Ibuprofen
Fluidized bed
Focused ion beam
Dissolution

ABSTRACT

Ibuprofen particles (mean particle size, 27 μm and melting point, 76 °C) as core materials were directly coated with a water-soluble polymer. The primary particles were preserved using a composite fluidized bed with a dispersing mechanism at the bottom of the fluidized bed apparatus. Coated primary particles were obtained under the following 3 conditions: (1) Setting the spray air flow rate at 10 L/min from the initial to 2% coating, (2) adding the low-viscosity water-soluble polymer macrogol 6000 to the hypromellose coating solution, and (3) changing the spray air flow rate to 15 L/min from 2% coating. The particles obtained were confirmed to be coated primary particles by scanning electron microscopy of their cross sections prepared by the cryo-focused ion beam method. The dissolution test showed a marked improvement in the solubility of ibuprofen from the coated primary particles compared with that of a physical mixture. In conclusion, the optimization of the direct coating process made it possible to undertake primary particle coating of a raw material that has a low melting point and a particle size of not more than 50 μm. Primary particle coating contributes to improvements in the physicochemical properties of drugs.

1. Introduction

Recently, the manufacturing process for fine particles of raw materials have been improved to increase their permeability and to increase their value in pharmaceutical formulations. Direct processing of these raw materials by coating of drug particles was attempted for surface modification [1,2], improved flowability [3–5], bitter taste-masking [6], and sustained release [7,8].

Coating methods include wet-spraying of solutions, mixing of dry materials, and drying of droplets [9]. Spraying solutions have been used to either coat granules with a typical fluidized bed and a tumbling fluidized bed, coat powders with a Wurster-type fluidized bed or agitation fluidized bed, etc. Methods using a fluidized bed have been evaluated widely, although microparticles of drugs generally have strong interparticle cohesive forces and low flowability [10]. The Wurster-based fluidized bed [9] and the agitation fluidized bed [6] methods have been developed to prevent unnecessary interparticle cohesion and maintain a satisfactory circulation of microparticles in the equipment. However, these methods are often employed to coat particles larger than 50 μm. To process finer particles, the particle size is often increased once by agglomeration to improve the flowability before coating [7,11–13]. Coating of latex over cornstarch with a particle size of 12 μm is an example of successful coating of primary microparticles without agglomeration. However, the drug content using this method has been shown to remain at only approximately 3% [14].

An example of successful solution coating of primary particles is coating of hydroxypropyl cellulose by simultaneous drying and film-forming after improving the flowability of cornstarch with 7-nm nano-silica [15]. In this case, pre-treatment using a special dry coating device was found to be necessary. Coating of cornstarch with hydroxypropyl cellulose has also been performed using a rotating fluidized bed coater that can control the fluidization of the material by adjusting the centrifugal force generated by rotation instead of gravity. The equipment has a very special structure and was found to be difficult to operate [16]. By coating ibuprofen particles of 42 μm diameter with hypromellose to improve the flowability, only a very thin membrane with 0.025% hypromellose relative to ibuprofen has been obtained [4]. As ibuprofen has a low melting point, the inlet temperature could not be increased, and only a very thin membrane could be prepared despite the long time needed for the process.

In coating using a water-soluble polymer, by which drying and film-forming are achieved simultaneously, agglomeration was found to be unavoidable. It has been shown to be very difficult to

Abbreviations: SFP, super fine processor; LASA, light anhydrous silicic acid; PM, physical mixture; SEM, scanning electron microscopy; FIB, focused ion beam.

* Corresponding author. Tel.: +81 476 27 1511; fax: +81 476 26 7948.
E-mail address: nobuo.miyadai@ssp.co.jp (N. Miyadai).

0921-8831/$ - see front matter © 2010 The Society of Powder Technology Japan. Published by Elsevier B.V. and The Society of Powder Technology Japan. All rights reserved.
doi:10.1016/j.apt.2010.12.004