Improving feeding powder distribution to the compaction zone in the roller compaction

Mingzhe Yu, Chalak Omar, Alexander Schmidt, James D. Litster, Agba D. Salman

PII: S0939-6411(17)30903-7
DOI: https://doi.org/10.1016/j.ejpb.2018.04.015
Reference: EJPB 12745

To appear in: *European Journal of Pharmaceutics and Biopharmaceutics*

Received Date: 6 August 2017
Revised Date: 15 April 2018
Accepted Date: 16 April 2018

Please cite this article as: M. Yu, C. Omar, A. Schmidt, J.D. Litster, A.D. Salman, Improving feeding powder distribution to the compaction zone in the roller compaction, *European Journal of Pharmaceutics and Biopharmaceutics* (2018), doi: https://doi.org/10.1016/j.ejpb.2018.04.015

IMPROVING FEEDING POWDER DISTRIBUTION TO THE COMPACTION ZONE IN THE ROLLER COMPACTION

Mingzhe Yu[1], Chalak Omar[1], Alexander Schmidt[2], James D. Litster[1] & Agba D. Salman[1]

1 Department of Chemical and Biological Engineering, University of Sheffield, Newcastle Street, Sheffield, S1 3JD, United Kingdom
2 Alexanderwerk AG, Remscheid, North Rhine-Westphalia, Germany
E-mail: myu14@sheffield.ac.uk

ABSTRACT

In the roller compaction process, powder flow properties have a significant influence on the uniformity of the ribbon properties. The objective of this work was to improve the powder flow in the feeding zone by developing novel feeding guiders which are located in the feeding zone close to the rollers in the roller compactor (side sealing system). Three novel feeding guiders were designed by 3D printing and used in the roller compactor, aiming to control the amount of powder passing across the roller width. The new feeding guiders were used to guide more powder to the sides between the rollers and less powder to the centre comparing to the original feeding elements. Temperature profile and porosity across the ribbon width indicated the uniformity of the ribbon properties. Using the novel feeding guiders resulted in producing ribbons with uniform temperature profile and porosity distribution across the ribbon width. The design of the feeding guiders contributed to improving the tensile strength of the ribbons produced from the compaction stage as well as reducing the fines produced from the crushing stage.

KEYWORDS

Roller compaction, Ribbon uniformity, Feeding guider, Temperature, Fines

1. INTRODUCTION

Roller compaction is a continuous dry granulation process, which is widely used in pharmaceutical and food industries. Moisture sensitive powders are able to be granulated, as there is no need to add liquid binder to produce agglomerates. Additionally, roller compaction is generally used because of its high efficiency, energy-saving and easy scale-up [1-4].

Roller compaction process mainly contains the feeding, compaction and crushing stages [5]. In the feeding stage, the powder is fed by gravity or screw feeder from the hopper into two counter-rotating rollers where compaction occurs. The moving powder is rearranged under low pressure in the feeding process [6]. When the powder starts to enter the compaction stage, it is compressed by the rollers. Compacted powder named as ribbon or flakes are released between the rollers from the other side. The ribbons and flakes then enter the crushing stage where granules are produced.

The ribbon properties are influenced by process parameters and powder properties in addition to the design of the roller compactor. For instance, roller force, gap and roller speed are the main process parameters that influence the tensile strength and the density of the ribbons [7-9]. The method of powder feeding to the compaction zone also plays a significant role in determining the ribbon quality. It was reported that the ribbon properties are not uniform across its width because of the powder feeding process as well as the side seal system used [4, 6, 10-13]. The screw flights push the powder forward, and the particles are arranged with time, which resulted in the powder