

Design of a Novel Dry Powder Inhaler (DPI)

Introduction

About half of the patients suffering from asthma and COPD do not adhere to their prescribed treatment, leading to a poor control of asthma symptoms. The major finding from a number of clinical studies is that 80% Indian patients are often neither compliant nor adhere to their treatment, and this lack of compliance and adherence has a direct effect on clinical efficacy.

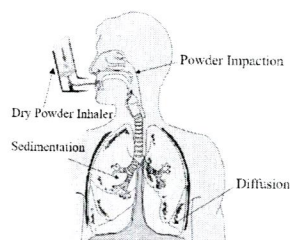


Fig-1

Need for a New Inhaler Design

The current pharmaceutical DPIs, however, have rather poor aerosol performance with very less dose being able to reach to the lungs. Particles with aerodynamic size range of 1-5 micrometers are required for the delivery to the more distal parts of the respiratory tract.

CAD Modeling of DPI Inhaler



Fig-2

The model is used to provide large number of particles to the mouth along with swirling motion so that drug particles can reach as deep as possible to the lungs. The figure shows the newly designed inhaler has three inlets. The two new tangential inlets are added in the device to provide swirl motion and one for axial flow.

Streamline flow Velocity contour in the newly designed Inhaler

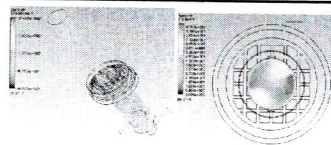


Fig-3

The streamlines and contour plot at the inhaler exit is shown in Fig.3 indicating the improved design due to swirl present in the flow. The outlet profile has a decentralized profile with a small region of flow. Streamline also indicates that pressure of large amount of swirl at capsule chamber.

As the airflow progresses towards the exit, the grid straightens the flow, however still swirl can be observed in the airflow.

Velocity contour in respiratory tract

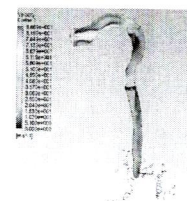


Fig-4

The Fig-4 represents the velocity contour at the respiratory tract for the new inhaler.

The Drug Particle deposition fraction at the oral cavity, trachea left wall and right wall are approximately 62.4, 3.51 and 3.23% respectively. The overall particle deposition efficiency is 20.07% with the newly designed DPI.

Significant Achievement

The optimized DPI design with improved drug deposition features is proposed. For improved performance, and ensuring that high amount of drug particles penetrate deeper into lungs with no significant losses in the device, a device has been developed that has the ability to generate both swirling motion and high axial velocity motion.

This signifies that the axial velocity generated in the device is able to deliver higher amount of drug to patient mouth while the swirling is able to send drug deeper into the lungs. Pharmaceutical companies may be interested in this prototype.

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