PERFORMANCE EVALUATION OF SPOUTED BEDS WITH NON-POROUS CYLINDRICAL DRAFT-TUBES APPLIED TO SAPONINS REMOVAL FROM BITTER QUINOA GRAINS

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ABSTRACT

This research work evaluates the use of draft-tubes in spouted beds applied to the process of saponins removal from bitter quinoa grains (yellow ecotype). Non-porous cylindrical draft tubes were used with lateral open surfaces of 30 and 50 mm in height measured from the bottom. The experimental runs used two conical cylindrical glass vessels of 7.44 and 14.34 cm diameter and cones of 30° and 45° respectively, provided with nozzles varying between 1.5 and 5 mm, connected to a digital flowmeter supplied with air by a compressor of 400 $Lmin^{-1}$ capacity. In tests of characterization of the bed with and without draft-tubes, experimental relationships among the linear velocity of air at the inlet of the spout, the gauge pressure, the volumetric flow of air, the particle's cycle time and the mass velocity of the circulation of solids were evaluated. Subsequently, a two-level factorial experimental design (2^4) was applied for the following factors: diameter of bed, diameter of gas inlet nozzle, height of bed and height of entrainment zone. As dependent variables, the loss of mass, concentration of saponins in the grain and specific energy consumption were evaluated. The highest saponin removal efficiencies correspond to the following geometrical conditions of the spouted bed with draft-tube: smaller nozzle diameter ($\emptyset_b$ = 2 mm), major distance of entrainment zone (H_D = 50 mm), major diameter of bed ($\emptyset_L$ = 14,4 cm) and lower height of bed (H_L = 21, 5 cm). Under these geometric conditions, after 81 minutes of processing, the draft-tube LFTS achieved a concentration of saponins (0.0325%) and a saponins removal efficiency of 52.64%. At higher linear air inlet velocities and higher grain cycle frequencies, better efficiencies of saponin removal and lower residual concentrations of saponins in the grain are obtained. In general, it can be concluded that to obtain minimum residual concentrations of saponins in the grains and removal efficiencies greater than 90%, any configuration that generates linear air inlet velocities of 1 000 to 1 300 ms^{-1} and frequencies of 20 CPM will be appropriate. Lower grain circulation mass flows in draft-tube spouted beds, compared to those obtained in conventional spouted beds, generate a lack of uniformity in the removal of saponins in the treated grains and lower efficiencies.

Keywords: Quinoa Saponins Removal, Draft-Tube Spouted Beds, Particle Mass Circulation Rate.

DOI: 10.23881/idupbo.019.1-3i