

UTILIZATION OF SILICA GEL AS A DESICCANT MATERIAL OF MOIST AIR USING IN DRING PROCESS

El-Ashmawy, N.M.; S.S. Hanna and M.K. El-Bakhshwan
Researcher, Agric. Ing. Res. Inst., Agric. Res. Center, Giza, Egypt.

ABSTRACT

The dehumidifying process of moist air before using in drying process not only reduces the energy consumption in drying process but also improve the performance of the process. In this work, a new concept is developed by making the ambient air flows parallel on silica gel bed. A certain amount of the humidity of incoming air, which is removed by silica gel, depends on many parameters; the weight and thickness of silica gel, air flow rate and the bed diameter. The experimental work was carried out to investigate the performance and energy saving during drying process using the silica gel bed system. The obtained results indicated that the silica gel can be used as a desiccant material for removing the ambient air humidity and therefore increasing its efficiency during drying process of the agricultural products. The optimal conditions were; 12.5 cm bed diameter, 0.053 kg/s air flow rate and 1.2 kg silica gel weight. At these conditions the maximum values of water absorption rate, temperature increase and energy saving were; 6.4 g/kg air, 11 C°, and 0.586 kW, respectively, and the minimum value of air moisture content (2.59 g/kg air) can be achieved.

INTRODUCTION

The use of fossil fuel in the mechanical dryers has become a common practice in Egyptian agriculture. With shortage and high price of fossil fuel, the reduction of energy consumption and the development and application of alternative energy source like solar energy become more and more important. The solar dryer uses the ambient air in the drying process; this ambient air usually has a high relative humidity and sequentially high moisture content. These characteristics of ambient air caused an increasing in energy consumption of solar dryer as a result of high moisture content of ambient air, which lead to increase the drying period. The dehumidifying process of moist air before using in drying process especially in solar dryer not only reduces the energy consumption but also improve the performance of drying process. Silica gel is hygroscopic, and responds to the relative humidity of the surrounding air. Because of its high internal surface area and its enormous number of angstrom-sized pores, this desiccant material has the ability to adsorb nearly 40 percent of its weight of water (Parsons, *et al.*, 1987).

Silica gel desiccant is widely used in industrial drying processes: generally the beds are relatively thick and can be designed using quasi-steady breakthrough methods. In recent years silica gel has been considered for solar evaporative-desiccant air conditioning systems, at which pressure drop constraints require use of thin beds (less than 15 cm thick). The operation of thin beds is inherently transient and current design procedures are based on models of the transient heat and mass transfer occurring in the bed. Such models represent the overall heat and mass transfer from the air stream to the silica gel by psuedo gas-side transfer coefficients (Pesaran and Mills, 1986).