J. Agric. Sci. Technol. (2007) Vol. 9: 15-23

Terminal Velocity of Chopped Corn Silage and Its Separate Fractions as Affected by Moisture Content

A. Hemmat[1*], M. Emamy[1], S. J. Razavi[1] and A. A. Masoumi[1]

ABSTRACT

Knowledge of the aerodynamic properties of agricultural materials is needed in equipment design for operations such as pneumatic conveying in loading/unloading operations of corn silage into/from silos. While considerable information is available on seed grains, little is known about the aerodynamic behavior of corn (*Zea mays* L.) silage. In this research, the weighed mean terminal velocity of a sample representative of the entire bulk mass was determined using Wolf and Tatepo's method. The terminal velocity of various particle types (leaf, stalk and corncob pieces) of chopped forage corn plants, which were kept in silo for six months, at different moisture contents (40-50, 50-60 and 60-70% w.b.) was also studied. The terminal velocity was determined by measuring the air velocity required to suspend a particle in a vertical air stream using a wind tunnel. A 3×3 factorial treatment arrangement with 30 replications in a completely randomized design was used to study the effect of moisture content and particle type on the terminal velocity. The mass mean terminal velocities of the corn silage at 40-50, 50-60 and 60-70% moisture contents were 7.1, 7.3 and 7.8 m/s, respectively. The results showed that only the effect of particle type on the terminal velocity of corn silage was significant. The mean values of the terminal velocity of corn leaf, stalk and cob pieces were 3.8, 6.8 and 8.8 m/s, respectively. For each particle type at a given moisture content, the terminal velocity was best described by means of the equation of velocity squared in terms of weight.

Keywords: Corn, Corncob, Leaf, Pneumatic conveying, Silage, Stalk, Terminal velocity.

INTRODUCTION

Pneumatic conveying may offer important functional and economic advantages in handling materials such as corn silage and low-moisture grass silage. Potential advantages include flexibility, safety, low initial costs, reliability and capability of handling difficult materials, such as haylage (Wolfe *et al.*, 1970). The utilization of forced-air streams for the transport and drying of agricultural materials is becoming increasingly important in Iran. It is, therefore, necessary that the aerodynamic characteristics of these materials be investigated so that their behavior in an air stream can be estimated with a degree of certainty, and so a fair basis on which to establish blower design can be provided. The most important aerodynamic characteristics to be considered are the suspension velocities of particles. The aerodynamic properties of agricultural products can be determined by recording the rate of acceleration of a particle falling in an enclosed tube or by measuring the air velocity required to suspend a particle in a vertical air stream. For a particle suspended in a vertical air stream, the particle weight acting downwards balances the buoyancy and drag forces acting upwards (Persson, 1991).

Agricultural materials are usually neither symmetrical in shape nor uniform in density. This lack of symmetry causes aerodynamic instability because the centers of gravity, lift

1. Agricultural Machinery Engineering Department, College of Agriculture, Isfahan University of Technology, Isfahan, 84156, Islamic Republic of Iran.
* Corresponding author, e-mail: ahemmat@cc.iut.ac.ir