International Agricultural Engineering Journal 2007, 16(3-4):97-113

EFFECTS OF MOISTURE CONTENT ON SOME ENGINEERING PROPERTIES OF TWO VARIETIES OF SAFFLOWER SEED

Mahdi Kashaninejad [*] and Maryam E. Rezagah[*]

ABSTRACT

The physical and engineering properties of bulk materials such as safflower are important to design the equipment for processing, transportation, sorting, separation and storing. In this study some engineering and physical properties of two varieties of safflower seed including principal dimensions, sphericity, geometric mean diameter, kernel volume, unit mass, bulk density, true density, porosity, terminal velocity and coefficient of static friction against different surfaces were evaluated as a function of moisture content in the range of 7 to 30% (w.b.). The results showed that all the physical properties of safflower seed to be dependent on their moisture content. An increasing relationship was found between principal dimensions, geometric mean diameter, unit mass, true density, porosity and moisture content in safflower seed while bulk density decreased with increase in moisture content. Terminal velocity and the coefficient of static friction increased linearly against all the tested surfaces as the moisture content increased. Individual volume and angle of repose for filling and emptying increased linearly with increasing of moisture content for both varieties.

Keywords**:** *Angle of repose; Density; Dimensions; Porosity; Safflower; Static Coefficient of Friction; Terminal Velocity*

1. INTRODUCTION

Safflower (*Carthamus tinctorius* L.) is a thistle-like annual plant mainly grown in dry hot climates as an oilseed or birdseed. It has many red, orange or yellow flowers on bushy plants. Flower heads are on the ends of stiff branches, with 15 to 30 seeds developing within each head. The seed is about the size of plump barley, either white or brownish and white with grey, brown or black stripes. The crop is seeded and harvested with the same equipment as is used for cereal grains. Safflower was originally grown in the Middle East and south Asia for the red/orange pigment in the flower petals which was used for colouring rice and bread, and dyeing cloth. After synthetic aniline dyes took over this market in the 1800's the crop was grown as an oilseed (Weiss, 1971).

Today this crop supplies oil, meal, birdseed, and foots (residue from oil processing) for the food and industrial products markets, although this crop is now primarily grown for the oil. There are two types of safflower varieties, the type that produces oil which is high in monounsaturated fatty acids (oleic acid), and those with high concentrations of polyunsaturated fatty acids (linoleic acid) (Weiss, 1983).

The meal that remains after oil extraction is used as a protein supplement for livestock. The meal usually contains about 24% protein and much fiber. Decorticated meal (most of hulls removed) has about 40% protein with a reduced fiber content. Foots are used to manufacture soap. The birdseed industry buys a small portion of the seed production. Sheep and cattle can graze succulent safflower and stubble fields after harvest (Giayetto *et al.*, 1999; Mohseni *et al.*, 2006).

Currently, the estimated world production is about 680 thousand tonnes of safflower seed from an area of 899 thousand ha land (FAOSTAT, 2005). Although Iran has a small share in the world production of safflower seed (about 500 tonnes), areas under safflower seed cultivation have lately increased in recent years because oilseed crops are in extensive demand in Iran to meet the lack of the country's oil.

There has been much effort and progress in developing the measurement techniques and accumulating data on physical properties of biological and agro food materials for the last three decades (Sessiz *et al.*, 2007). The major moisture-dependent physical properties of biological materials are shape and size, bulk density, true density, porosity, mass, friction against various surfaces, terminal velocity and

[*] Department of Food Science & Technology, Gorgan University of Agricultural Sciences and Natural Resources, Gorgan, Iran, Corresponding author E-mail: kashaninejad@yahoo.com, kashani@gau.ac.ir.