MOISTURE DESORPTION ISOTHERMS AND ISOSTERIC HEAT OF SORPTION CHARACTERISTICS OF MALTING BARLEY (HORDEUM DISTICHUM L.)

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I. INTRODUCTION

World production of malting barley (Hordeum distichum L.) amounts to 155 million tons of which Argentina contributes about 1.68 mill. tons of barley (SAGPyA, 2010). Most of the deterioration mechanisms of plant products are associated with water activity and moisture content, so the drying process is essential to maintain their quality. Full knowledge of the hygroscopic and thermal properties of the grains is crucial for the mathematical description of drying and rewetting of the grain and to find the optimum operating conditions for drying and storage. Sorption isotherms of products are highly relevant to model moisture uptake during storage and distribution. The net isosteric heat of sorption is a thermodynamic parameter obtained from equilibrium data for sorption isotherms it represents the difference between the latent heat of adsorption and the latent heat of condensation of pure water (Rucklo et al., 1999). Heat of sorption varies throughout the drying process, depending on both temperature and moisture-content of the grain to be different in the heat of vaporization of pure water (Rucklo et al., 2003). A mathematical model that includes these factors in calculating the latent heat of vaporization is an appropriate tool for designing efficient and economical drying. Isosteric heat of sorption with sorption isotherms are essential tools for the proper design of storage systems. Very little work is available on the equilibrium moisture content of barley. Vermuganti et al. (1980) published experimental equilibrium data of barley in the ranges 5-40°C and 30-90% relative humidity; the researchers adjusted these values by the Chung-Pfost equation. Chen and Morey (1989) adjusted different models to experimental data at low temperatures (5-25°C). Brooker et al. (1992) reported equilibrium moisture content data of barley at 25°C. Sun and Woods (1994) studied the dynamic equilibrium moisture content for desorption in the range restricted to low temperatures from 3.9 to 19.6°C. ASAE (2003) reported only sorption equilibrium data in tabular form at temperatures between 25-28°C and the parameters of the Chung-Pfost equation valid in the ranges 5-25°C of temperature and 18-95% of relative humidity. Basunia and Abe (2005) determined the dynamic equilibrium moisture for adsorption at temperatures between 5.7 and 46.3°C. Also, Neagu et al. (2009) studied the adsorption moisture isotherms of barley at ambient temperatures (16-25°C). No studies were found about desorption equilibrium moisture content for a more wide range of temperatures applicable to the drying of barley. Therefore, further information on the sorption equilibrium between the grains of barley and the environment is requested in order to properly interpret the mechanisms contributing to the kinetics of wetting and drying operations, as well as for the selection of appropriate storage conditions of dehydrated products. On the other hand, Chen and Morey (1989) noted, after studying four isotherms equations for a set of 36 data of sorption, that there is not a “universal” isotherm capable of adequately describing the equilibrium in the behavior of all types of biological materials. These authors found that the Modified Halsey equation and the Modified Oswin equation were appropriate for the adjustment of commodities with high contents of oil and protein. The GAB isotherm, which was adequate to represent mathematically the sorption equilibrium data of different cereals, oilseeds and sub-products (Chen and Jayas, 1998; Pagan and Mascheroni, 2003; 2005; Cassini et al., 2009), is difficult to use because of the complexity of the expression of water activity as a function of humidity and...