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FLUIDIZED-BED DRYING OF PARBOILED RICE

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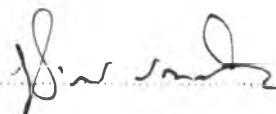
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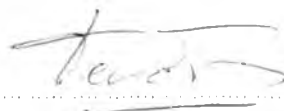
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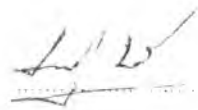
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หัวข้อวิทยานิพนธ์	การทำข้าวหนึ่งไหแห้งในฟลูอิคไซเบค
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บทคัดย่อ

ข้าวหนึ่ง เป็นสินค้าออกที่สำคัญประเภทหนึ่งของประเทศไทย แต่ในปัจจุบันกรรมวิธีการผลิตข้าวหนึ่ง ในขั้นตอนของการทำข้าวหนึ่งไหแห้ง เป็นสิ่งที่ควรได้รับการแก้ไขปรับปรุงจากแบบที่นิยมทำกัน โดยใช้วิธีตากแดดซึ่งทำให้สิ้นเปลืองเงินทุนและแรงงานคน อีกทั้งให้ผลผลิตที่ไม่แน่นอนในทางคุณภาพและปริมาณ

เทคนิคทางฟลูอิคไซเบคเป็นวิธีที่มีผู้นำไปใช้ในการทำให้ผลิตภัณฑ์หลายอย่างแห้ง โดยไคยลคี้ ดังนั้นจึงได้นำมาประยุกต์ใช้กับการทำข้าวหนึ่งไหแห้ง โดยขั้นตอนของงานวิจัย เริ่มด้วยการออกแบบและสร้างฟลูอิคไซเบค ศึกษาการทำงานของเครื่องมือวิจัยทั้งแบบต่อเนื่องและไม่ต่อเนื่อง จากนั้นจึงได้เก็บข้อมูลการวิจัยโดยมีตัวแปรที่พิจารณาคือ เวลา อัตราการไหลของอากาศ อุณหภูมิของอากาศร้อน และอัตราการผลิตข้าว เพื่อหาความสัมพันธ์กับอัตราการทำข้าวหนึ่งไหแห้ง อัตราการถ่ายเทความร้อน สมบัติประสิทธิของการถ่ายเทความร้อน และวิเคราะห์ผลที่ได้หลังการสีข้าว ซึ่งทำให้ได้สภาวะที่เหมาะสมที่สุดในการใช้ฟลูอิคไซเบคในการทำข้าวหนึ่งไหแห้ง

จากผลการทดลอง แสดงให้เห็นว่าเทคนิคทางฟลูอิคไซเบคสามารถนำมาใช้กับการทำข้าวหนึ่งไหแห้งได้อย่างมีประสิทธิภาพสูง ระบบที่ใช่ควรเป็นระบบที่มีการป้อนข้าวแบบต่อเนื่อง เพราะจะทำให้สะดวกรวดเร็ว โดยไคยลคี้ที่มีคุณภาพดี ปริมาณมากพอเหมาะที่ต้องการ ฉะนั้นสภาวะที่เหมาะสมที่ควรนำไปใช้คือ อุณหภูมิของอากาศร้อน ๑๘๐ องศาเซลเซียส อัตราการไหลของอากาศ ๐.๖๕ กิโลกรัม ต่อ วินาที ต่อ ตารางเมตร และอัตราการผลิตข้าวหนึ่ง ๓๑.๖ กิโลกรัม ต่อ ชั่วโมง

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ABSTRACT

Parboiled rice is one of the most important exported product of Thailand. Normally, the drying step in production of parboiled rice is performed by means of the conventional method of using sun drying. This uneffective method of drying needs to be improved since it requires high capital investment and labor work, and the quality of product obtained has no consistency.

Fluidized-bed is one of the techniques that has been successfully applied in drying many types of products. Therefore, this technique was selected to be used in drying of parboiled rice.

First, the fluidized-bed column was designed and constructed. The operational systems, batch and continuous types, were studied. Four variables were taken into consideration, namely; time, air flow rate, temperature of hot air, and feed rate. The experiment was conducted and the data obtained was used to calculate the relationships between the rate of drying, the rate of heat transfer, the heat transfer coefficient, and

the results obtained from milling were observed to find the optimum conditions in drying of parboiled rice by using fluidized-bed.

It was shown from the experimental results that the fluidized-bed technique is suitable for drying of parboiled rice with high efficiency. The system used should be continuous type operation with screw feeder since it gives a convenient, fast operation, and yields high quality products at any quantity required. The optimum conditions selected were 183°C of air inlet temperature at the air flow rate of 0.65 kg/sec.m^2 and the production rate of 31.59 kg/hr .

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NOMENCLATURE

- a' = specific surface or surface of solid per volume of solid, m^{-1}
 A_c = cross-sectional area of tube or bed, m^2
 A_s = surface area of bed, m^2
 c = empirical constant of Eq.(2-5), dimensionless
 C_{pg} = specific heat of air, Joule/kg. $^{\circ}K$
 d_p = diameter of sphere having the volume of the paddy, m
 P = production rate of parboiled paddy, kg/sec
 g = $9.80 m/sec^2$, acceleration of gravity
 g_c = $980 gm.cm/(gm-wt)(sec)^2$, conversion factor
 h_p = heat transfer coefficient between hot air and parboiled paddy, Joule/sec. m^2 . $^{\circ}K$
 k_g = thermal conductivity of air, Joule/sec. m . $^{\circ}K$
 L_m = height of fixed bed, cm.
 L_{mf} = height of bed at minimum fluidizing conditions, cm.
 m = empirical constant of Eq.(2-5), dimensionless
 M = moisture content (dry basis)
 N_{up} = $h_p \cdot d_p / k_g$, Nusselt number for hot air-parboiled paddy heat transfer, dimensionless
 Δp = pressure drop across bed, cm. H_2O
 q_h = rate of heat transfer, Joule/sec
 Q_0 = volumetric air inlet flow rate, m^3/sec
 R = dM/dt , rate of drying, gm. H_2O evaporated/gm.dry paddy.hr

$Re_p = d_p \cdot U_o \rho_g / \mu_g$, parboiled paddy Reynolds number,
dimensionless

t = drying time, min.

t' = drying time after tempering, min.

Tg_b = temperature of air in bed, $^{\circ}C$

Tg_i = temperature of air inlet, $^{\circ}C$

U_{mf} = superficial air velocity at minimum fluidizing
conditions, m/sec

U_o = superficial air velocity through a bed of parboiled
paddy, m/sec

W = weight of bed, kg.

ϵ_{mf} = void fraction in a bed at minimum fluidizing
conditions, dimensionless

ϵ_m = void fraction in a random packed bed, dimensionless

μ_g = viscosity of air, kg/m.sec.

ρ_g = density of air, kg/m^3

ρ_s = density of paddy, kg/m^3

ϕ_s = sphericity of paddy, dimensionless