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OPTIMAL OPERATING CONDITIONS & EQUILIBRIUM CHARACTERISTICS OF RICE BRAN OIL EXTRACTION

M.Sc (Chemical and Process Engineering)

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University of Moratuwa
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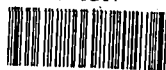
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OPTIMAL OPERATING CONDITIONS & EQUILIBRIUM CHARACTERISTICS OF RICE BRAN OIL EXTRACTION

By

N. C. Gangodavilage

This thesis was submitted to the Department of Chemical and
Process Engineering of the University of Moratuwa in partially
fulfillment of the Degree of Master of Science in Chemical
and Process Engineering



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ABSTRACT

Rice bran is the cuticle between the paddy husk and the rice grain and is obtained as a byproduct in rice processing. The bran contains 12-25 wt% oil and approximately 98% is extractable. Rice bran oil is a very important source of oil, both as an edible oil and non-edible oil. The oil has high medicinal value, due to presence of anti-oxidants, anti-cancer agents, cholesterol reducing agents, skin improving agents, anti-dandruff and anti-itching agents. The oil can also be used for production of soap, surfactants, cosmetic formulations, emulsifiers, textile auxiliaries, synthetic rubber products etc.

In this work, extraction of rice bran oil from various brands of rice bran available in Sri Lanka has been studied. Experiments were conducted using pilot plant scale leaching unit and the soxhlet apparatus to extract rice bran oil using hexane as the solvent. The key factors controlling the extraction have been identified. Results show that the bran obtained from parboiled paddy has a higher yield of rice bran oil compared to the raw rice bran. Method of bran pretreatment, extraction temperature, extraction time, pellet size and free fatty acid content are the factors affecting oil extraction. Comparison of extraction results by various pretreatment methods shows an enhancement of oil extractability due to steaming. Analysis of the extracted oil shows that steaming is the most effective method of bran pre-treatment with respect to the FFA content. Pelletization of bran provides easy percolation and avoids channeling of the solvent and contamination of the oil from fine solids. Results show a decrease in extraction rate with time and this may be due to the fact that the solute has to diffuse from the interior of the pellet in the later stages of extraction.

Extraction of rice bran oil using organic solvents was compared with aqueous extraction. The highest yield for aqueous extraction was obtained at 70 °C and pH 12. Refined and raw rice bran oil and commonly used vegetable oils were analyzed and the results were compared. Tie line and mass transfer data necessary for batch and continuous leaching equipment design were determined.



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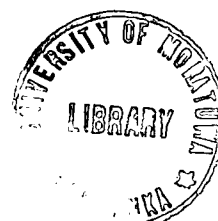
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NOMENCLATURE

A_i	–area of solid liquid interface
A	–solute
AOCS	- American oil chemist association
ASTM	– American Standard Testing Methods
C	- concentration of the solute in the bulk of the solution
C^*	- concentration of the solute at the surface of the solid
C_0	- initial concentration of solute in the solution
D	– inert or solid phase
D_{co}	– Diffusion coefficient
DOB	– deoiled bran
dt	– change in time
dw	– change in mass
E	– extract
Ef	- Weight faction of extract
F	- feed
FFA	- free fatty acids
IPA	– isopropyl alcohol
K_{co}	– mass transfer coefficient
N	– normality
ppm	– parts per million
R	–raffinate
RBO	– rice bran oil
Rf	- Weight faction of raffinate
Rh	– relative humidity
rpm	– Rounds per minute
S	–Solvent
SCC	– Supercritical Carbon Dioxide
Sf	- Weight faction of solvent
t	– time
V	– volume
Xf	– Weight faction of Feed
ρ_s	– reduced density