

**ADSORPTION OF POTASSIUM IONS FROM  
VINASSE USING STRONG ACID CATION  
EXCHANGE RESIN**

**By**

***Eng. Eman Nader Abdulwahhab Moustafa***

**A Thesis Submitted to the  
Faculty of Engineering at Cairo University  
In Partial Fulfillment of the  
Requirements for the Degree of  
MASTER OF SCIENCE  
In  
Chemical Engineering**

**FACULTY OF ENGINEERING, CAIRO UNIVERSITY  
GIZA - EGYPT**

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**FACULTY OF ENGINEERING, CAIRO UNIVERSITY  
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**Title of Thesis:**

**ADSORPTION OF POTASSIUM IONS FROM VINASSE USING  
STRONG ACID CATION EXCHANGE RESIN**

**Key Words: Vinasse, Adsorption, Isotherm, Potassium sulfate, fertilizers, ion  
exchange resins**

**Summary:**

Vinasse is the principal liquid waste effluent resulting from alcohol distillation unit, caused by beet or cane molasses fermentation. Increasing awareness of environmental issues in recent years has resulted in a number of technologies being applied for the vinasse treatment as it contains high COD, BOD and mineral nutrients. A possibility of producing the potassium sulfate fertilizer in the form of solution was investigated by adsorption of potassium ions from vinasse and then eluting the latter by sulfuric acid solution.

Vinasse was passed through strong acid cation exchange resins columns which adsorb potassium ions. Three technique of adsorption were used (Batch, Semi batch, and Fixed bed). Desorption of potassium was performed using  $H_2SO_4$  solution forming potassium sulfate solution (15 % conc.), which could be used as a fertilizer, while the remaining vinasse free-potassium can be used in animal feed preparation.

It was observed that the adsorption capacity increases by increasing the flow rate, decreasing of initial concentration and decreasing temperature. The highest desorption capacity was achieved at 0.4M sulfuric acid solution and temperature of 35°C.

From economic study, it is concluded that the produced potassium sulfate solution cost is about 120.5 L.E/ton while the imported  $K_2SO_4$  costs 1,400 L.E/ton, The selling price is 785L.E/ton, the annual return will be L.E, payback time = 6 months.

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### List of abbreviations

CEC	Cation exchange capacity
GHG	Greenhouse gas
BOD	Biological oxygen demand
COD	Chemical oxygen demand
UASB	Up flow anaerobic sludge blanket
SCOD	Soluble chemical oxygen demand
DM	Dry matter
DS	Dissolved solids
GM	Grape marc
BW	Body weight
MAS	Molasses alcohol stillage
EC	Electrical conductivity
ED	Electro dialysis
RO	Reverse osmosis
MTZ	Mass transfer zone
BDST	Bed depth service time
PDM	Pore diffusion model
PSDM	Pore and surface diffusion model
HSDM	Homogenous surface diffusion model
EBT	Eriochrome black T
EDTA	Ethylene di tetra amine
CMC	Condensate soluble vinasse
PLC	Programmed logic control