Dedication

This thesis is dedicated to **my family**, for all the love and support they gave me during the many years I spent studying.

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This thesis is dedicated to **my father**, who taught me that the best kind of knowledge to have is that which is learned for its own sake.

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This thesis is dedicated to **my mother**, who taught me that even the

Largest task can be accomplished if it is done one step at a time.

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ABSTRACT

Liquid-Liquid extraction is a separating unit operation process which is well known and well investigated, however, the equilibrium data For mutual solubility and tie lines are difficult to correlate and be applied. Many workers including Othmer and Tobias, Ishida, and Hand introduced methods that predict Liquid-Liquid tie-line data, but the mutual solubility data is still plotted on binodal curve on equilateral triangle.

The construction of the tie –line on the binodal curve to determine the number of theoretical stages, has to be made graphically using the relevant correlations. This requires experimental determination of the mutual solubility and tie-line data.Treybal even prior to Hand and other workers introduced a method of construction without using tie-lines data of binodal curves to determine the number of theoretical stages. This method is investigated and proved to be correct, rapid and does not require experimental determination of tie-line data.

Treybal method is used in the present work and proved to be accurate and easy to apply. The number of stages is determined using this

method and all other design parameters of a sieve tray extraction column are obtained.

A complete design by hand calculation procedure is realized and Outlined. The number of theoretical stages is calculated using ASPEN PLUS SOFT WARE and it is found to be in agreement with the method investigated in this thesis.

This work also investigates the preparation of the data required to design a distillation column .It is known from the literature and practice that distillation is well known and well investigated ,However, different techniques have been used to determine the design parameters. These include the minimum reflux ratio, the actua reflux ratio, the number of theoretical stages, the number of actual stages, the feed stage location, ,the flooding velocity,the liquid-vapor flow factor,the maximum volumetric flow rate,the net area,the active area ,the hole area,the weir length,the entertainment,the weeping,the weir crest and actual minimum vapor velocity are lastly determined.

The design of adistillation column requires experimental determination and correlation of equilibrium data. The equilibrium data and component balance are used to calculate the number of theoretical stages and consequently the other design parameters. An adequate literature is cited covering the activity coefficient models such as NRTL, UNIOUAC and UNIFAC. Data obtained by these methods are used to design a distillation using ASPEN PLUS SOFTWARE .The design is also made through hand calculations and found to be asatisfactory agreement with ASPEN PLUS SOFTWARE result .Acomplete procedure by hand calculations for designing extraction and distillation columns .

[illegible]

عملية استخلاص السوائل بالمذيبات السائلة من عمليات الفصل المعروفة وقد تم بحثها جيدا وعلى الرغم من ذلك فأن قابلية الذوبان المشتركة وخطوط الربط يصعب تطبيقها. وكثيراً من العلماء بحثوا في هذا المجال ومنهم (Othmer and Tobias, Ishida, Hand) والذين قدموا طرقا للتنبؤ ببيانات خطوط الربط وقابلية الذوبان المشتركة التي ترسم على منحني عقد الاتزان الثنائي (binodal curve) في مثلث متساوي الاضلاع .

ترسم بيانات خطوط الربط علي منحني عقد الاتزان الثنائي (binodal curve) لتحديد عدد المراحل النظرية والذي يجب ان يرسم بيانيا باستخدام خطوط الربط وهذا يتطلب اجراء تجارب لتحديد قابلية الذوبان المشتركة وبيانات خطوط الربط . العالم (Treybal) الذي سبق (Hand) ابتدع عرض طريقة لتحديد عدد المراحل النظرية بدون استخدام بيانات خطوط الربط علي منحني عقد الاتزان الثنائي (binodal curve) وقداثبت في هذا البحث ان هذه الطريقة صحيحة وسريعة ودقيقة وسهلة التطبيق ولا تتطلب القيام بتجارب لتحديد بيانات خطوط الربط كما تم تحديد عدد المراحل وجميع بيانات التصميم الاخري لتصميم صينية المناخل في برج الاستخلاص ولقد تم التوصل الي اجراء تصميم كامل بالحساب يدوياً وا لياً.

كما تم حساب عدد المراحل النظرية باستخدام برامج (ASPEN PLUS SOFTWARE) والذي أدي الي نتائج مطابقة مع الطريقة المثبتة في هذا البحث قد تم في في هذا البحث ايضا اعداد البيانات المطلوبة لتصميم برج التقطير .

وشملت اليات في تصميم برج التقطير وتشمل نسبة الراجع الدنيا ونسبة الراجع الفعلية وعدد المراحل النظرية وعدد المراحل الفعلية كما شملت تحديد موضع دخول التغذية وسرعة الفيضان ونسبة التدفق الحجمية وتم تحديد المساحة الصافية والمساحة النشطة ومساحة الثقوب

وتضـــمنت البيانـــات ارتفـــاع الحـــاجز ومعـــدل ســـحب الســـائل مـــن البخار(الاصطياد) وقمة الحاجز وسرعة البخار الدنيا وقد استعملت بيانات الاتزان وموازنة المواد لحساب عدد المراحل النظرية ومعـاملات التصـميم الاخري.

وقد شمل أدبيـات البحـث الدراسـات السـابقة لنمـــاذج المعامـــلات النشـــاطية (NRTL, UNIOUAC, UNIFAC) و استخدمت هذة المعـاملات لتصميم عمود التقطير باستخدام (ASPEN PLUS SOFTWARE).

وتم ايضا اجراء العمليات الحسابية للتصميم يدويا والتي وجدت انها تتفق تقربيا مع نتائج (ASPEN PLUS SOFTWARE) ووضعت طريقة متكاملة وواضحة لحساب بيانات التصميم يدويا وا لياً.

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Diluent

Solute
Solvent

Concentration of diluent in diluent rich phase
Concentration of solute in diluent rich phase
Concentration of solvent in solvent rich phase
Concentration of solute in solvent rich phase
Concentration of diluent in solvent rich phase
Concentration of solvent in diluent rich phase
Feed
Extract
Raffinate
Mixture
Non-Random Two Liquid model
Universal Quasi-Chemical Theory model

Universal Functional Activity Coefficient
Weight fraction of substance (C) in Feed
Weight fraction of substance (C) in Solvent
Weight fraction of substance (C) in Extract
Weight fraction of substance (C) in Raffinate
Weight fraction of substance (C) in Mixture
The difference point
R^2 The correlation factor
Jet diameter
Orifice diameter
Density of continuous phase
Density of dispersed phase
Interfacial tension
The velocity through perforations (orifice)
Perforation area
Volumetric rate of dispersed solution
Volumetric rate of continuous solution
Number of perforations
Plate area for perforations
The continuous phase velocity
The terminal velocity
Viscosity of continuous solution
Acceleration of gravity
Conversion factor
Downspout area
Total plate area
Tower Diameter
Stage Efficiency
The number of actual stages
The number of theoretical stages
Tower Height
The tray spacing
Molar flow rate of feed
Molar flow rate of over head product
Molar flow rate of bottom product
Mole fraction of light liquid
Mole fraction of light in over head product
Mole fraction of light in bottom product
The minimum reflux ratio
The Reflux Ratio
Liquid flow in rectifying section
Vapor flow in rectifying sections

Liquid flow in stripping sections
Vapor flow in stripping sections
Flooding vapor velocity
Density of liquid
Density of vapor
The liquid-vapor flow factor
Volumetric flow-rate
Molecular weight
Net area required
Down comer area
Column diameter
Cross-sectional area of downcomer
Net area
Active area
Hole area
Weir length
Entrainment
Minimum vapor velocity through the holes
Hole diameter
Weir crest