User's Manual

MCTH

Chemical Software

Number of Theoretical Plates by McCabe-Thiele Method

VAXA SOFTWARE

www.vaxasoftware.com

INDEX

Introduction

MCTH is a Windows application to calculate the Number of Theoretical Plates of a distillation tower using the McCabe-Thiele Method.

This manual isn't about McCabe-Thiele Method or distillation theories.

Please, read this manual carefully in order to learn all the capabilities of the application.

◆ ***Note:***
Design, price and specifications are subject to changes without notice.

Terms of use

Vaxa Software will not be responsible for the direct or indirect damages or damages caused by the use or impossibility of use of this application, nor by the effects in the operation of other applications or the operating system.

Before the installation we recommended to make backup of your data and create a restoration point.

You will be able freely to evaluate the application shareware during the time that considers necessary. Passed this period of evaluation you would have or to register it or uninstall it.

In order to register the application, please see the option "REGISTER APPLICATION" in the help menu of the application.

After paying the registry rights you will receive by email the REGISTRATION KEY of the application.
Once registered the application, it will be able to use the options that were disabled until that moment.

The REGISTRATION KEY is UNIQUE for EACH COMPUTER.

You can not use the same REGISTRATION KEY for multiple computers.

You can freely distribute unaltered copies of the installation system of the application to other users.

You cannot decompile the application nor use no type of reverse engineer for its analysis or modification.

You cannot use part or the totality of the application to create a new application.

Conflicts of shared files:
VaxaSoftware not responsible for conflicts due to the incompatibility of shared files (*. dll, *. ocx and other files).

VaxaSoftware applications use shared files (*.dll, *.ocx and other files).
It is possible that the shared file exists and whether or not previously replaced by a different version during the installation of the VaxaSoftware application.
This can cause the VaxaSoftware application not work and/or a third party application that shares the same file does not.

Also the installation of a third party application can cause the application of VaxaSoftware or third party application does not work.

VaxaSoftware will try to resolve these conflicts in a reasonable manner, despite its satisfactory resolution is not guaranteed and in many cases may be impossible.

Main window: *Left panel*

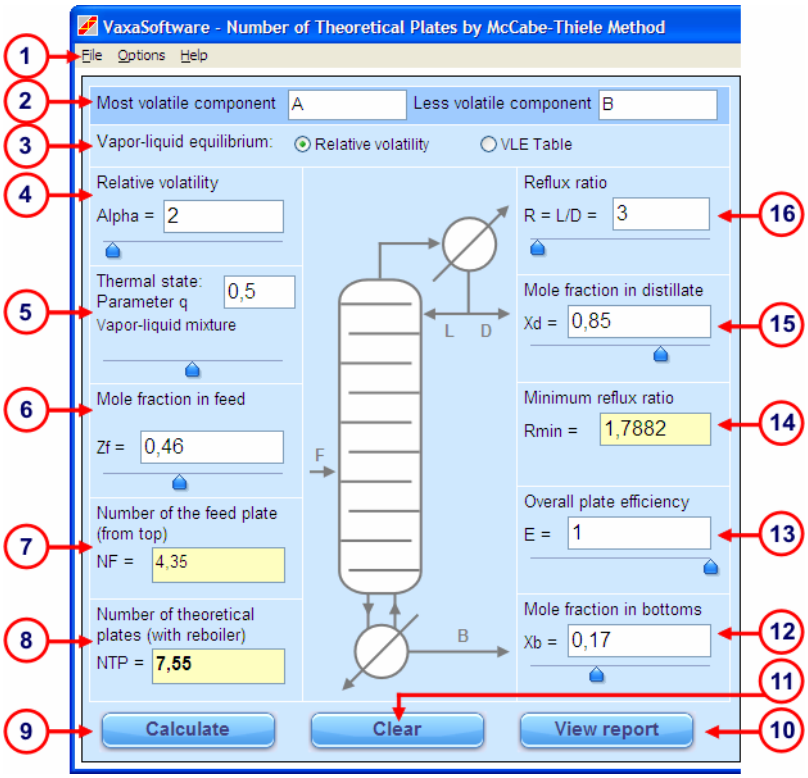


Fig. 1
Main window: *Left panel*

(1) Menu bar

It contains the menus *File*, *Options* and *Help*.

File menu

Calculate
Calculates output values from input values.

Open...
Allows us to open a McCabe-Thiele file (*.mct).

Save
Saves the current data as a McCabe-Thiele file (*.mct).

Save as...
Asks us for a filename and saves the current data as a McCabe-Thiele file (*.mct).

Print...
Open the *Print* window to print a brief report showing:

- Input data.
- Equations of operating lines and q-line.
- Intersection of q-line and the operating lines
- Table of VLE: Vapor-Liquid Equilibrium:.
- McCabe-Thiele diagram.
- Table of theoretical stages.

Exit
Close the application.

Options menu

Interface Language / Idioma de la Interfaz
Allow us to select the following interface languages:
- English.
- Español (Spanish).

Decimal separator:
We can select either point [.] or comma [,] as decimal separator.
The output values are shown using the selected decimal separator.

Help menu

User's manual (PDF document)...
Show this manual.

Application registration...
Show the registration form window to register the application.

Disabled functions in the unregistered version
Show the list of disabled functions when the application is not registered.

Home page (www.vaxasoftware.com)...
Connect to VaxaSoftware home page.
An active Internet connection and a browser are required.

About...
Show the *Splash* window with the version and description of the application.

(2) Name of components

Allows us to enter the following name of components.
- Most volatile component.
- Less volatile component.

◆ ***Note:***
All mole fractions are the most volatile component.

(3) Vapor-liquid equilibrium

Allow us to select the following method for vapor-liquid equilibrium (VLE):

Relative volatility.
Use this option if the vapor-liquid equilibrium has a constant relative volatility.

Table.
Use this option if the vapor-liquid equilibrium has a variable relative volatility and/or there is azeotrope.
Click the *Edit table* button to edit the Vapor-Liquid Equilibrium table.

(4) Relative volatility

Allows us to enter the relative volatility α (alpha).

◆ ***Note:***
Scientific notation:
The scientific notation is used to show very big or very small numbers.
A scientific notation number has a mantissa and a power of 10.
In order to enter a scientific notation number we use letter E to input the exponent of 10.

Examples:
5.67×10^{89} is entered as 5.67 E 89
1.23×10^{-34} is entered as 1.23 E-34

(5) q parameter

Allows us to enter the q parameter: Thermal state of feed.

(6) Mole fraction in feed

Allows us to enter the mole fraction in feed (Zf).

(7) Number of the feed plate: NF

Shows the number of the feed plate (counting from top).

(8) Number of theoretical plates: NTP

Shows the number of theoretical plates (with reboiler, counting from top).

(9) *Calculate* button

Calculates output values from input values.

(10) *View report* button

Shows a detailed report for the input data showing:
- Input data.
- Equations of operating lines and q-line.
- Intersection of q-line and the operating lines
- Table of VLE: Vapor-Liquid Equilibrium:.
- McCabe-Thiele diagram.
- Table of theoretical stages.

(11) *Clear* button

Clears all the input/output values.

(12) Mole fraction in bottoms

Allows us to enter the mole fraction in bottoms (Xb).

(13) Overall plate efficiency

Allows us to enter the overall plate efficiency.

(14) Minimum reflux ratio

Shows the Minimum reflux ratio: Rmin.

(15) Mole fraction in distillate

Allows us to enter the mole fraction in distillate (Xd).

(16) Reflux ratio

Allows us to enter the Reflux ratio: R.

Main window: *Right panel*

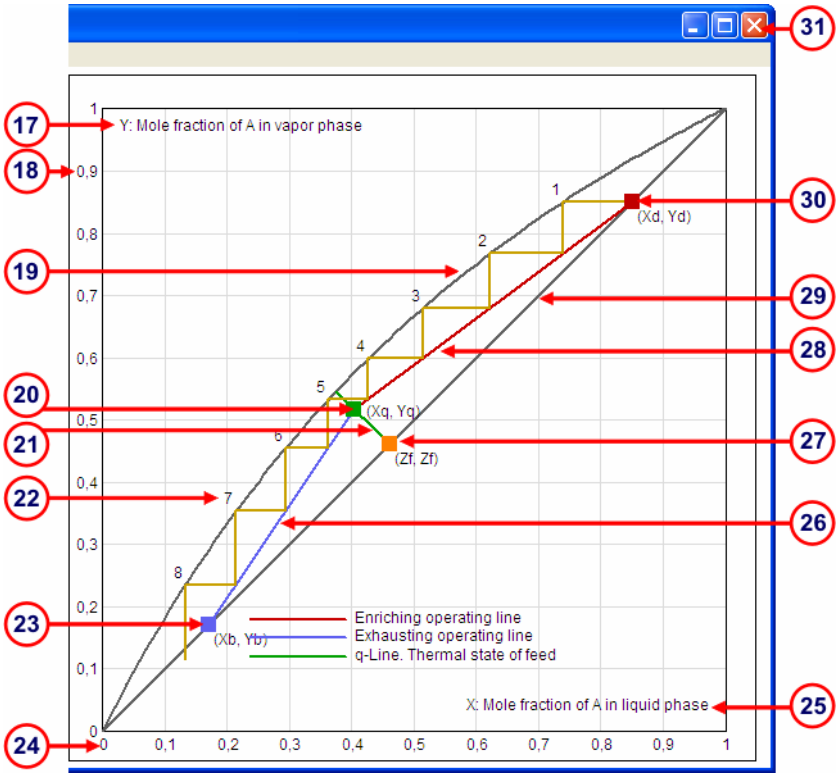


Fig. 2
Main window: *Right panel*

(17) Y-axis title

Shows the Y-axis title.

(18) Scale of values of Y-axis

Shows the scale of values of Y-axis.

(19) VLE curve: Vapor-liquid equilibrium curve

Shows the VLE (Vapor-Liquid Equilibrium) curve.

- You can modify the curve with the mouse when using constant relative volatility. The relative volatility is changed while you move the curve.

- If you use a table of VLE you can double click on the curve to edit the VLE table

(20) *q*-point

Shows the q-point (intersection of q-line and the operating lines).

- You can move the q-point with the mouse. The following values will be changed:
    - Operating lines
    - q-line
    - Reflux ratio
    - q parameter (thermal state of feed).

(21) *q*-line

Shows the q-line.

(22) Number of each theoretical plate

Shows the number of each theoretical plate (counting from top).

(23) Mole fraction in bottoms

Shows the point of the mole fraction in bottoms.
You can move this point with the mouse

(24) Scale of values of X-axis

Shows the scale of values of X-axis.

(25) X-axis title

Shows the X-axis title.

(26) Exhausting operating line

Shows the exhausting operating line.

(27) Mole fraction in feed

Shows the point of the mole fraction in feed.
You can move this point with the mouse

(28) Enriching operating line

Shows the enriching operating line.

(29) y = x line

Shows the y = x line.

(30) Mole fraction in distillate

Shows the point of the mole fraction in distillate.
You can move this point with the mouse

(31) Window control buttons

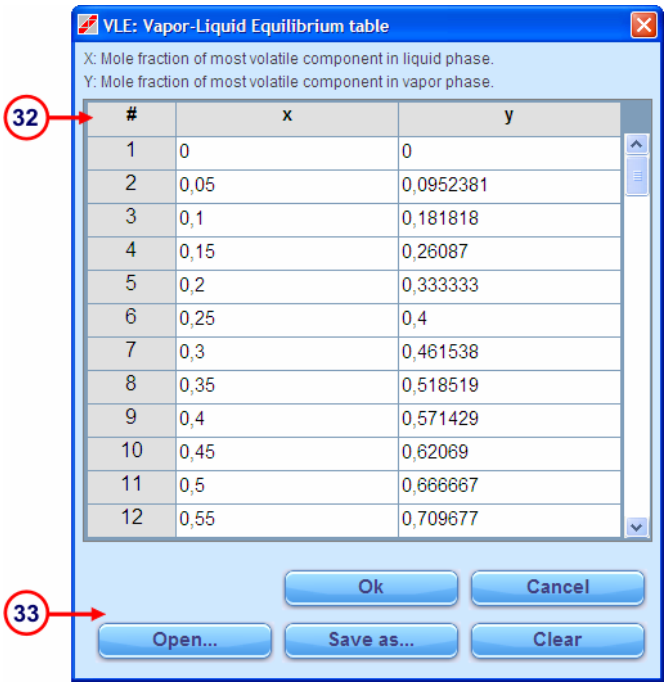
These are the classics buttons of the windows of MS-Windows ®.

Minimize button
Minimizes the application to an icon on the desktop.

Maximize / Restore button
Maximizes / restores the application's window size.

Close button
Closes the application. Also we can press Alt + F4 keys on our keyboard.

Window: *VLE: Vapor-Liquid Equilibrium table*



#	x	y
1	0	0
2	0,05	0,0952381
3	0,1	0,181818
4	0,15	0,26087
5	0,2	0,333333
6	0,25	0,4
7	0,3	0,461538
8	0,35	0,518519
9	0,4	0,571429
10	0,45	0,62069
11	0,5	0,666667
12	0,55	0,709677

Fig. 3
Window *VLE: Vapor-Liquid Equilibrium table*

(32) Data table

Allows us to enter the values of X and Y of a VLE (Vapor-Liquid Equilibrium).

(33) Buttons

Ok button
Checks the table, closes the dialog window and returns to the main window. The edited data table will be used.

Cancel button
Closes the window. The edited data is not used.

Open... button
Allows us to open a file of table (*.vle) or import a McCabe-Thiele file (*.mct)

Save as... button
Asks us for a filename and saves the current table as a file (*.vle).

Clear button
Clears the table.

Example

We want distillate an ethanol-water mixture as show below:
Mole fractions:
Feed: $Z_f = 0.46$
Distillate: $X_d = 0.85$
Bottoms: $X_b = 0.17$
Reflux ratio R = 3
Parameter q = 0.5 (vapor-liquid mixture)
Overall plate efficiency = 1
The VLE data will be entered from a file (Ethanol-water.vle)

Procedure:

1) Introduce the mole fraction of feed, distillate and bottoms, reflux ratio, parameter q and overall plate efficiency.

2) Select *Table* in Vapor-Liquid Equilibrium section.

3) Press *Edit table...* button to open the *VLE* window.

4) Press *Open* button to open the table *Ethanol-water.vle* that is in *Example* subfolder located in the directory where the application was installed.

5) Press OK button to close the window and return to main window.

6) Press *Calculate* button in the main window to finish.

Results:

Number of Theoretical Plates:
NPT = 18.33 (with reboiler, counting from the top)

Number of the feed plate:
NF = 17.2 (counting from the top)

Minimum reflux ratio:
Rmin = 1.04

The McCabe-Thiele diagram is shown in Fig. 4 below.

More results:

Click *View report* button to see a detailed report showing:
- Input data.
- Equations of operating lines and q-line.
- Intersection of q-line and the operating lines
- Table of VLE: Vapor-Liquid Equilibrium:.
- McCabe-Thiele diagram.
- Table of theoretical stages.

Printing results:

Press *File / Print...* menu to print a brief report showing:

- Input data.
- Equations of operating lines and q-line.
- Intersection of q-line and the operating lines
- Table of VLE: Vapor-Liquid Equilibrium:.
- McCabe-Thiele diagram.
- Table of theoretical stages.

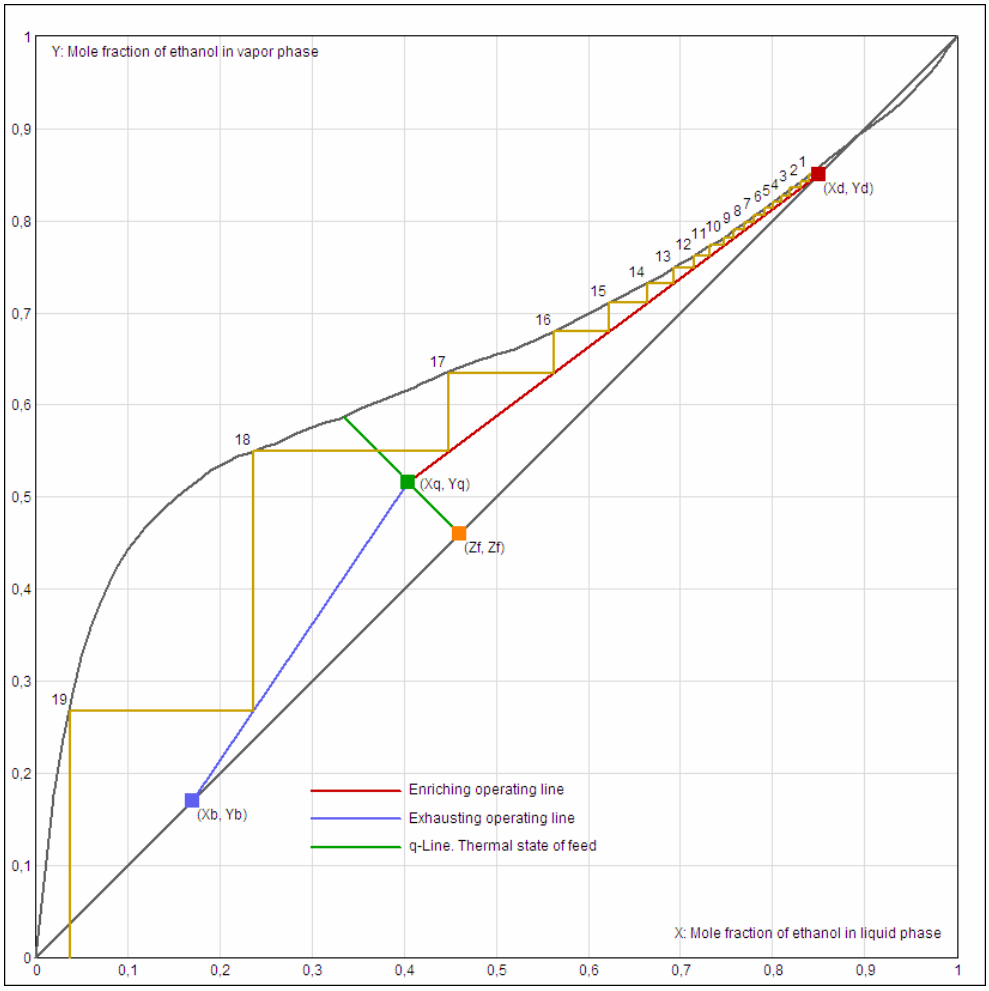


Fig. 4
McCabe-Thiele diagram of Ethanol-water distillation

Shortcut keys

Main window

F5	Calculate
Ctrl + O	Open...
Ctrl + S	Save
Ctrl + P	Print...
Ctrl + F4	Exit
Alt + F4	Exit
F1	Help: Show User's Manual (PDF document...)
Shift+F1	About...

Specifications

Description	***MCTH*** is a Windows application to calculate the number of theoretical plates in a distillation tower using McCabe-Thiele method.
License	Trialware
Interface Languages	English / Spanish.
Decimal separator	Point or comma.
McCabe-Thiele distillation files:	- McCabe-Thiele files (*.mct).
VLE (Vapor-Liquid Equilibrium) data input	- Relative volatility. - Table of VLE (or files *.vle / *.mct).
Azeotrope support	Yes
Maximum number of theoretical plates	495

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