

User's Manual

THEN
Version 2.4.2

Number of theoretical plates of distillation columns using McCabe-Thiele method

Windows 7[®] - Windows 8[®] - Windows 10[®]



INDEX

Introduction.....	3
Terms of use.....	3
Main window: Left panel.....	4
Main window: Right panel.....	8
Window: VLE: Vapor-Liquid Equilibrium table.....	10
Example:.....	11
Shortcut keys.....	13
Specifications.....	13
Registered trademarks.....	14

Introduction

This is a Windows application to calculate the Number of Theoretical Plates of a distillation column 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.

Terms of use

In no event shall VaxaSoftware be liable to anyone for direct, indirect, special, collateral, incidental, or consequential damages by the use or impossibility of use of the software, nor by the effects in the operation of other software 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 software during the time that considers necessary. Passed this period of evaluation you would have or to register it or uninstall it.

To register the software, please see the option "REGISTER APPLICATION" in the help menu of the software.

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

The REGISTRATION KEY is UNIQUE for EACH COMPUTER.

You cannot use the same REGISTRATION KEY for multiple computers.

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Main window: Left panel

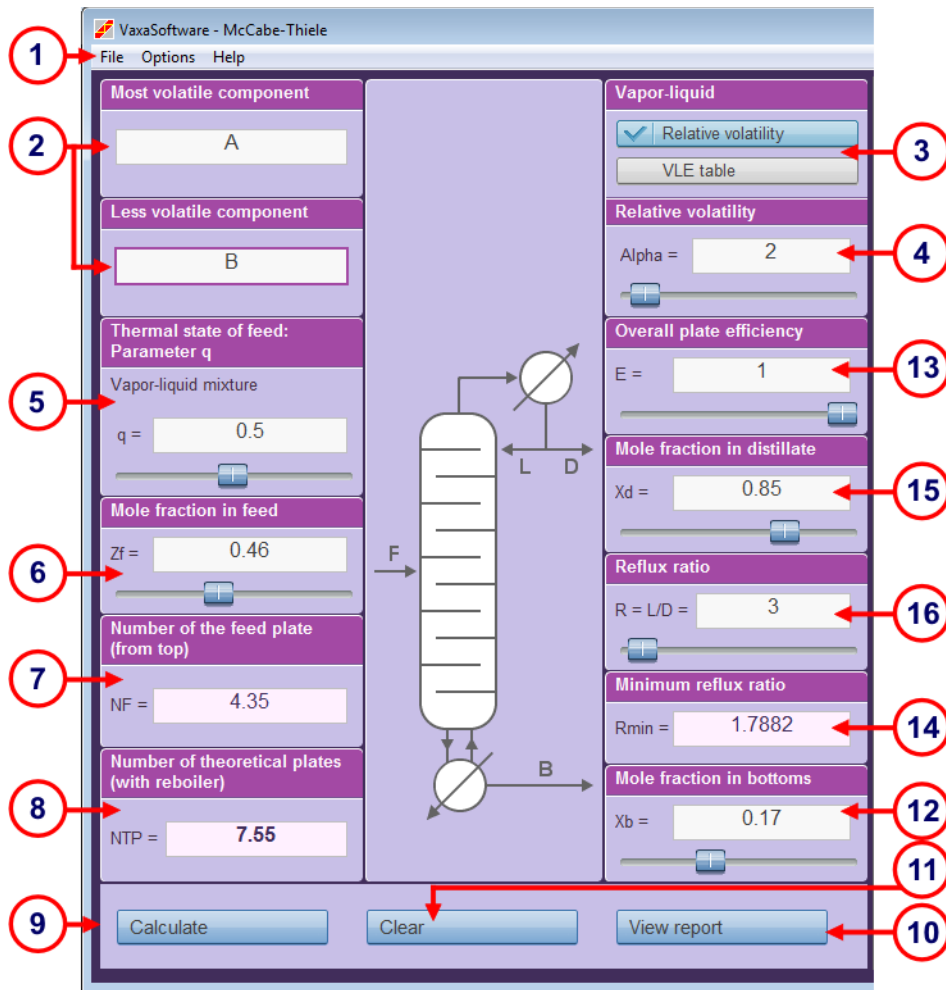


Fig. 1 - Main window: Left panel

1 Menu bar

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

File menu

Calculate

Calculates output values from input values.

Clear

Clears all the input/output values.

View report

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.

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**Decimal separator:**

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

Theme

Allows you to select a color theme for the user interface.

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.

Updates**Check now...**

The software connects to Internet to check for updates.
An active Internet connection is required.

Update period...

Allows us to adjust the period between checks for updates.

The following settings are available:

- Once a day.
- Once a week.
- Once a month.

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

Allows 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 (Z_f).

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 (X_b).

13 Overall plate efficiency

Allows us to enter the overall plate efficiency.

14 Minimum reflux ratio

Shows the Minimum reflux ratio: R_{min} .

15 Mole fraction in distillate

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

16 Reflux ratio

Allows us to enter the Reflux ratio: R .

Main window: Right panel

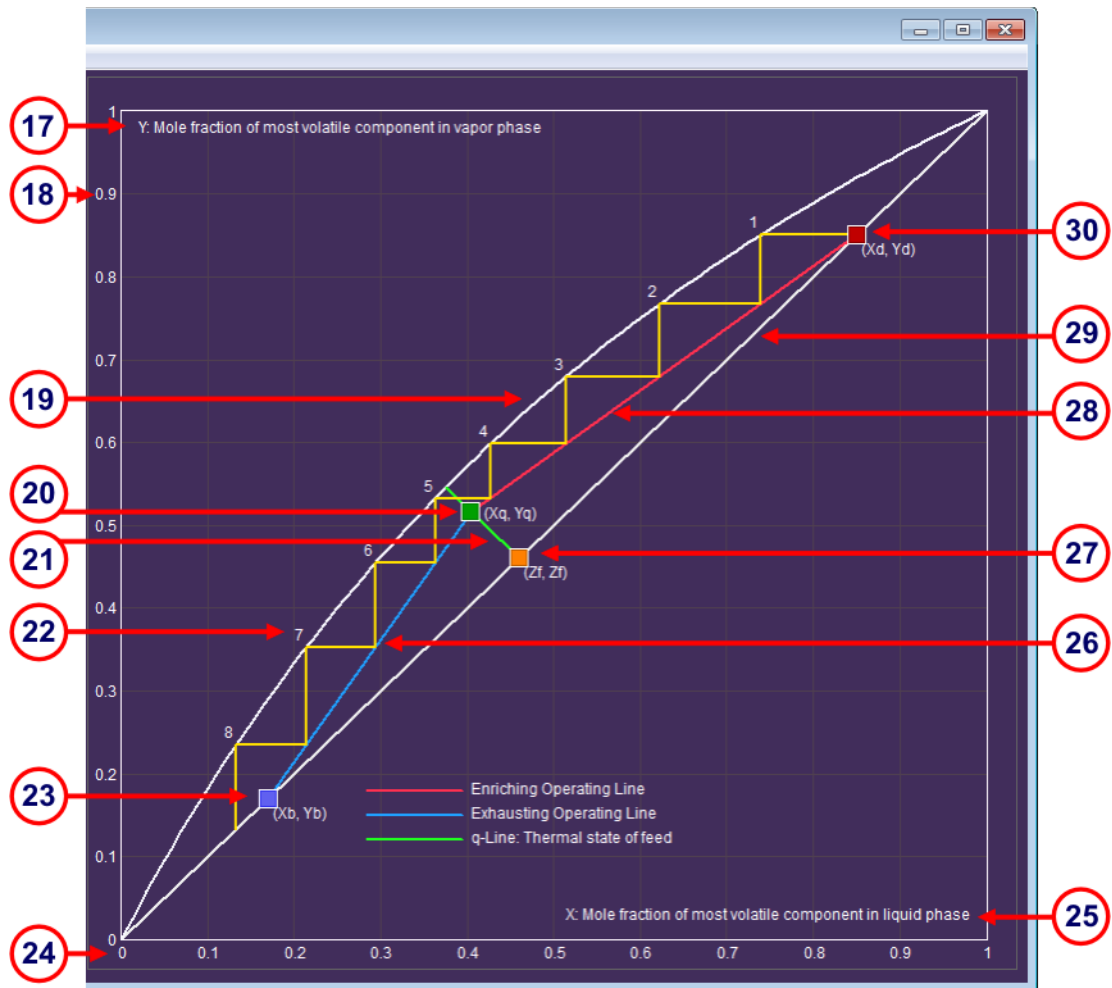


Fig. 2 - Main window: Right panel

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

Window: VLE: Vapor-Liquid Equilibrium table

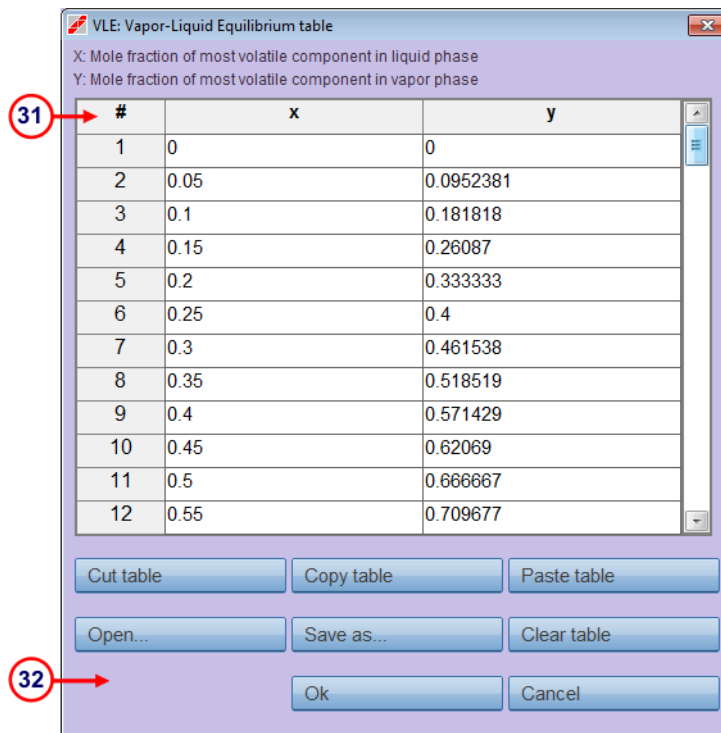


Fig. 3 - Window VLE: Vapor-Liquid Equilibrium table

31 Data table

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

32 Buttons

Cut table button

Copies the table to the clipboard and then clears the table.

Copy table button

Copies the table to the clipboard.

Paste table button

Pastes a table from the clipboard.

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 table button

Clears the table.

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.

Example

We want to distillate an ethanol-water mixture as shown 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:

$R_{min} = 1.04$

The McCabe-Thiele diagram is shown in Fig. 4 in the next page.

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.

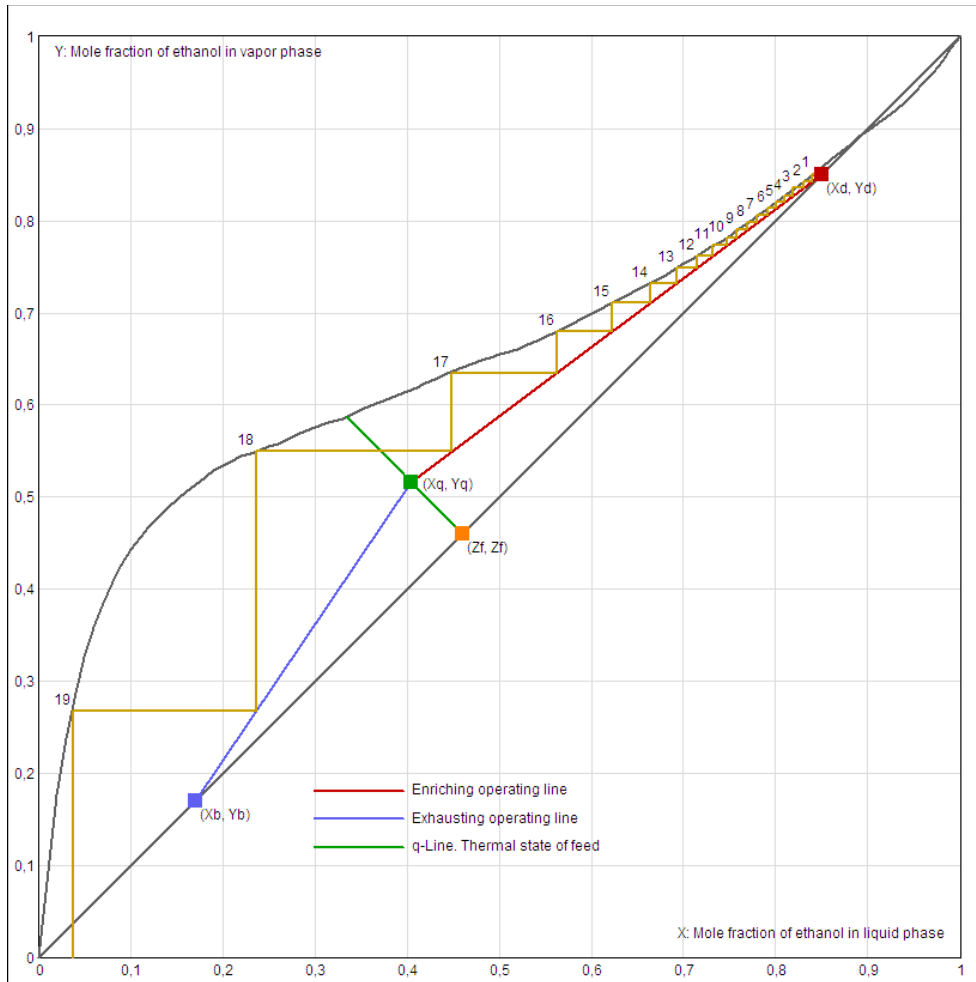


Fig. 4 - McCabe-Thiele diagram of Ethanol-water distillation

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	<i>"THEN"</i> is a Windows application to calculate the number of theoretical plates in a distillation column using McCabe-Thiele method.
License	Demo.
Interface Language	English.
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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