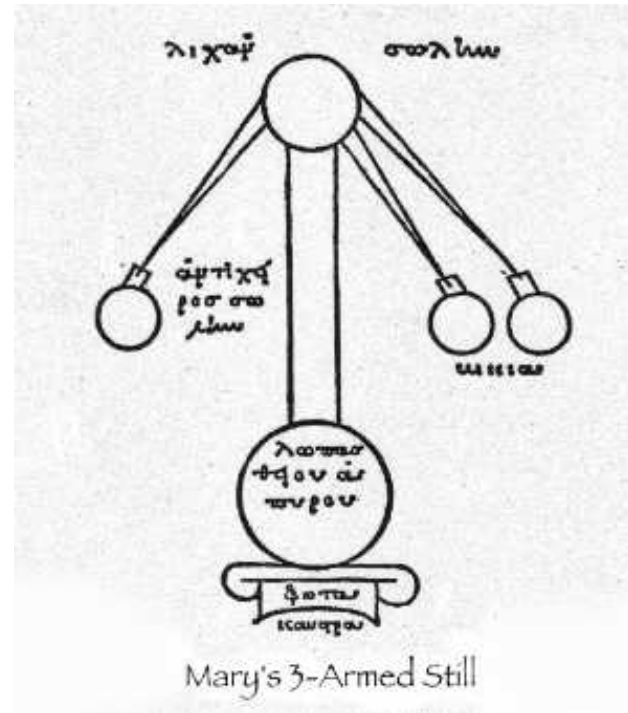




## MARIA THE JEWESS

### Alexandria around AD 100

<http://www.womeninscience.org/then2.htm>



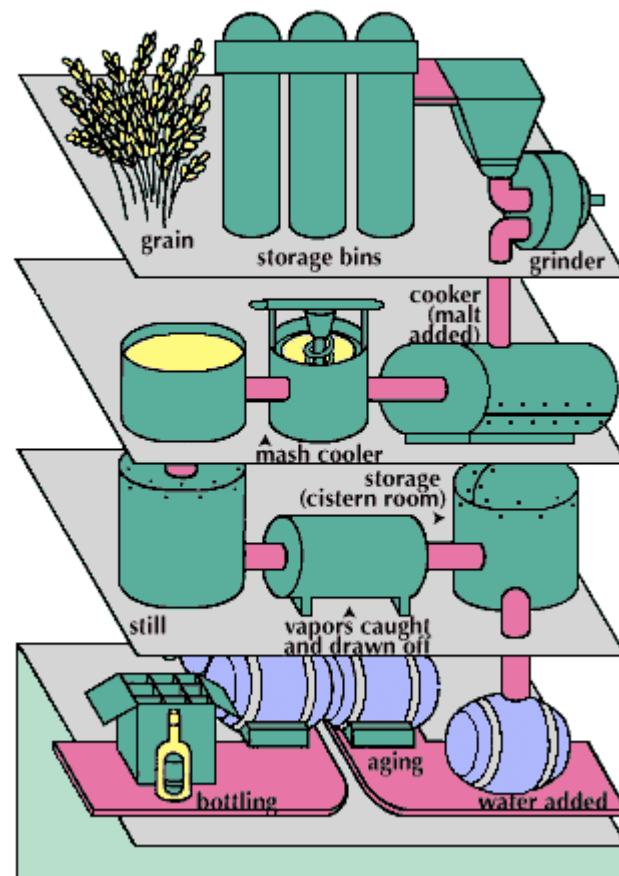
[http://www.hypatiamazet.org/chem/alchem\\_1a.html](http://www.hypatiamazet.org/chem/alchem_1a.html)



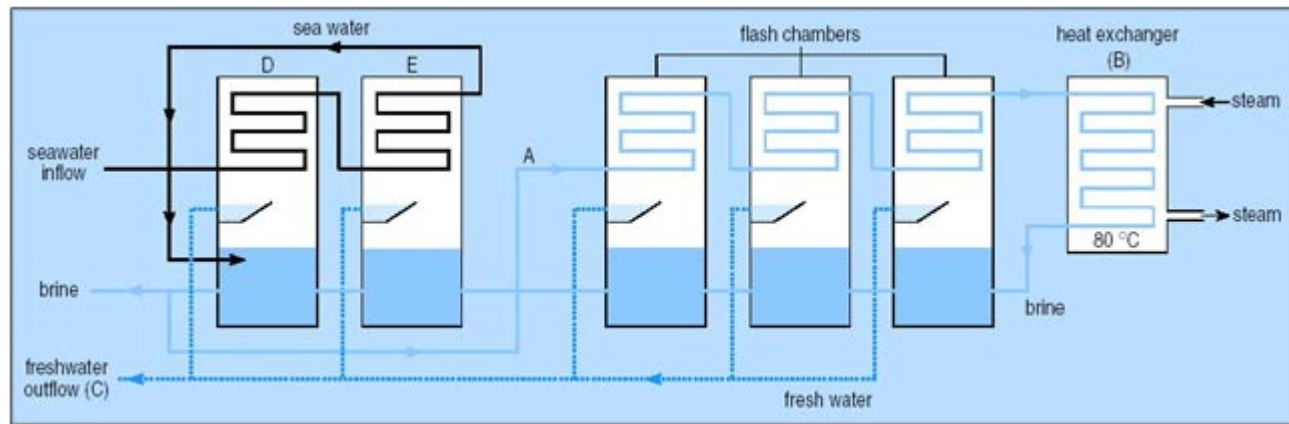
Laboratory of stills -  
Bruno Court Perfumery  
- Grasse - first half of  
the 20th century

[http://www.museesdegrasse.com/MIP/fla\\_ang/techno\\_09.shtml](http://www.museesdegrasse.com/MIP/fla_ang/techno_09.shtml)

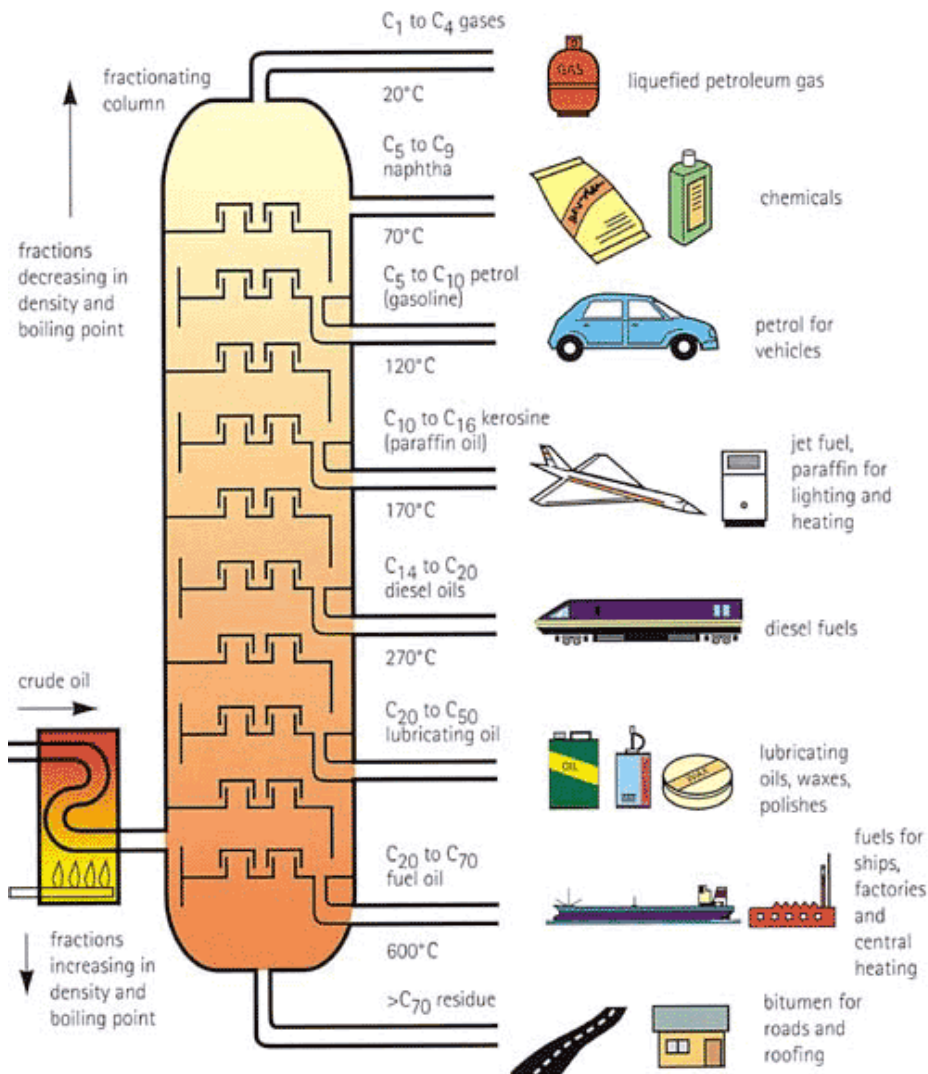
#### WHISKEY PRODUCTION



<http://images.google.com/imgres?imgurl=http://cache.eb.com/eb/image%3Fid%3D63104%26rendTypeId%3D4&imgrefurl=http://student.britannica.com/comptons/art-53574/The-fermentation-and-distillation-process-in-producing-whiskey-begins-with&h=470&w=318&sz=17&hl=en&start=28&um=1&tbnid=onT4IHSYI7AMfM:&tbnh=129&tbnw=87&prev=/images%3Fq%3Ddistillation%2Bstill%26start%3D18%26ndsp%3D18%26um%3D1%26hl%3Den%26rls%3DGGLJ,GGLJ:2006-43,GGLJ:en%26sa%3DN>



[http://openlearn.open.ac.uk/file.php/2457/T210\\_1\\_034i.jpg](http://openlearn.open.ac.uk/file.php/2457/T210_1_034i.jpg)



<http://images.google.com/imgres?imgurl=http://www.energyinst.org.uk/education/coryton/images/column.gif&imgrefurl=http://www.energyinst.org.uk/education/coryton/page7.htm&h=622&w=500&sz=58&hl=en&start=12&um=1&tbnid=5MLh-N2L3fIEQM:&tbnh=136&tbnw=109&prev=/images%3Fq%3Ddistillation%2Bpictures%26um%3D1%26hl%3Den%26rls%3DGGLJ,GGLJ:2006-43,GGLJ:en>

## How biodiesel is made

### MIXING OF METHANOL AND CATALYST

A catalyst, typically sodium hydroxide, is dissolved in methanol (wood alcohol).

### REACTION

The methanol/catalyst mix and oil or fat are added together and heated, producing a reaction called "transesterification," which results in two major products: glycerin and biodiesel. Technically, biodiesel is methyl esters.

### SETTLING

Glycerin is much more dense than biodiesel, and the two can be gravity-separated, with glycerin simply drawn off the bottom of the settling vessel.

### WASH

Biodiesel must be washed with water to remove contaminants. Water is heavier than biodiesel and absorbs the excess methanol, sodium hydroxide and soap suspended in it. After washing and settling, the water can be drained from the bottom of the container. Several wash cycles are generally needed.

### METHANOL RECOVERY

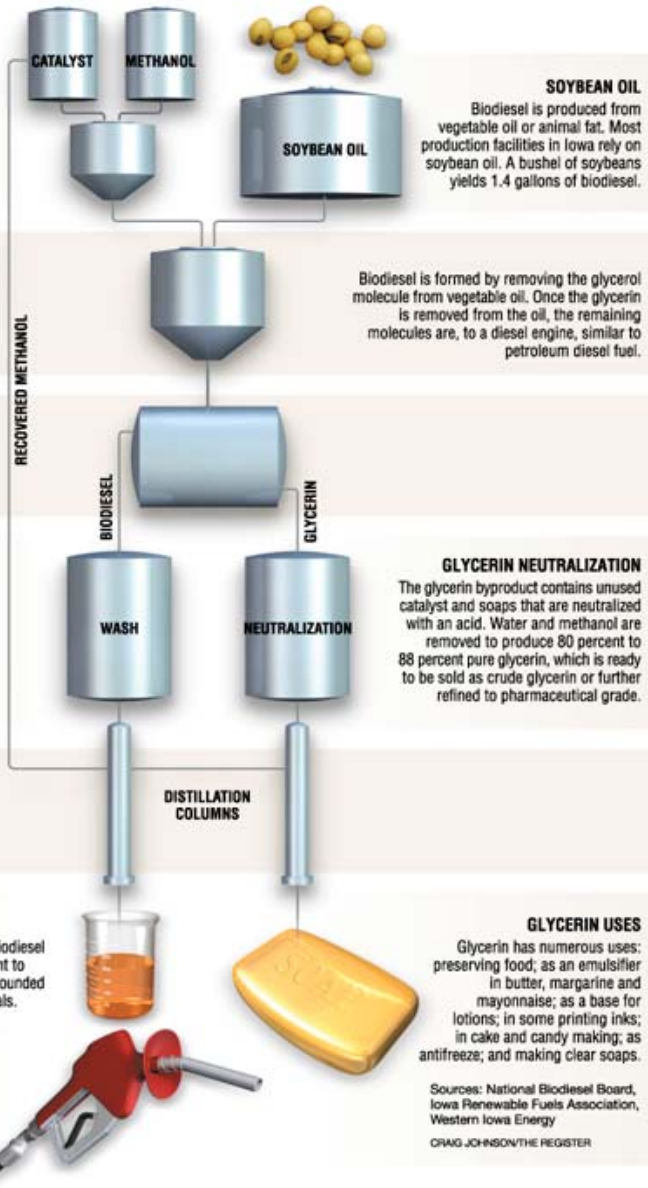
Excess methanol remaining in the biodiesel and glycerin are removed through distillation and recycled for reuse.

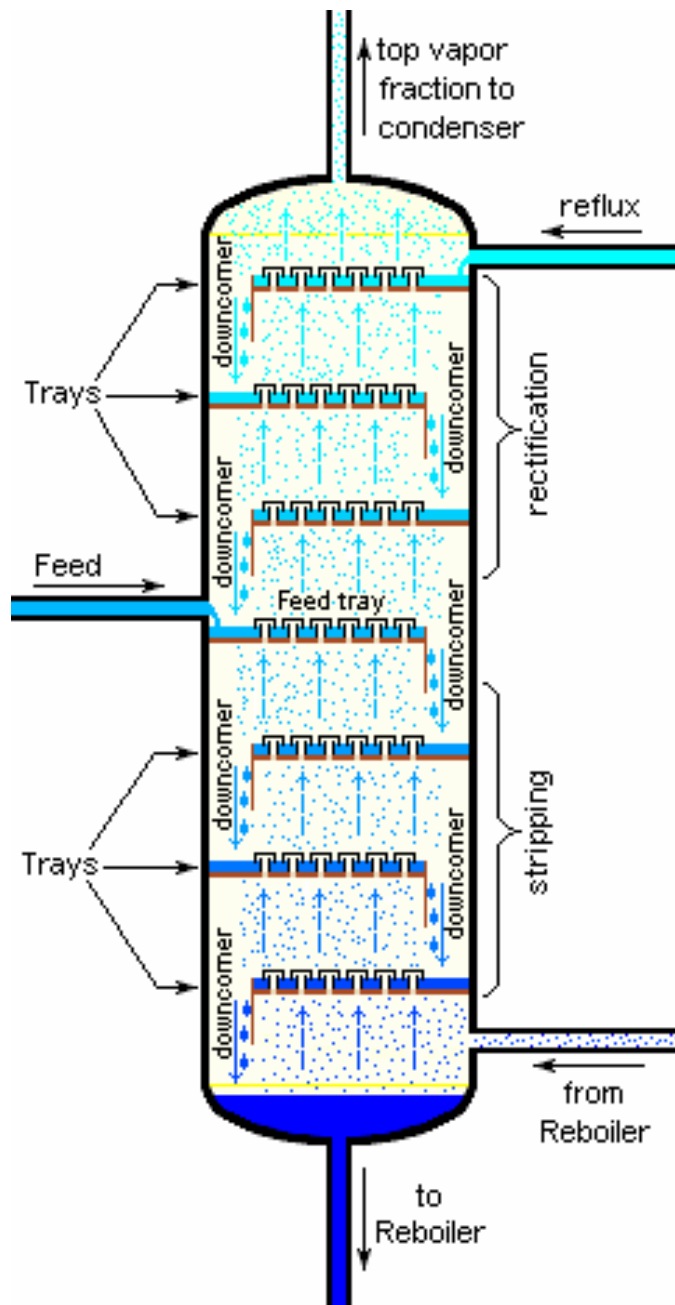
### PRODUCT QUALITY AND REGISTRATION

Prior to use as a commercial fuel, the finished biodiesel must be analyzed using sophisticated equipment to ensure it meets ASTM specifications. ASTM was founded as the American Society for Testing and Materials.

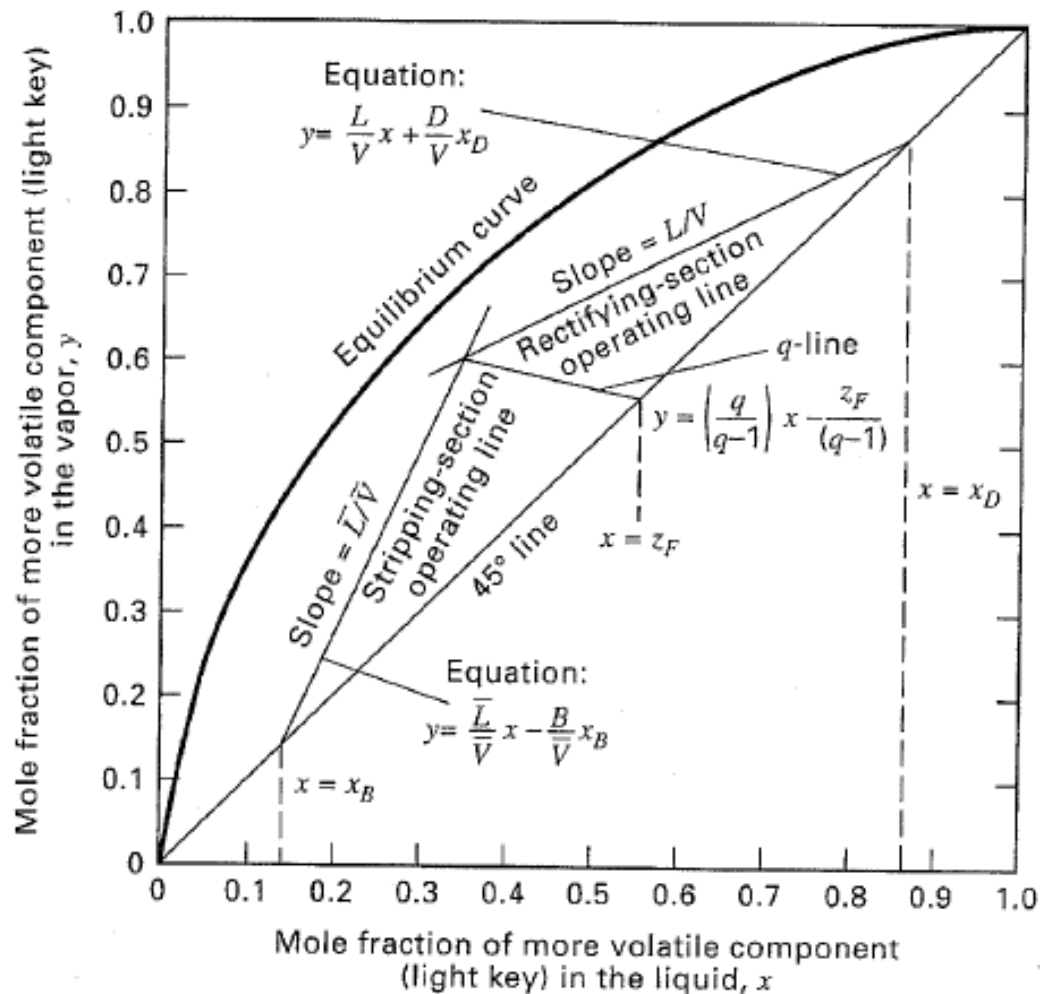
### FINAL PRODUCT

The finished biodiesel is shipped to fuel distributors by rail or truck, to be sold as pure biodiesel or blended with petroleum diesel.



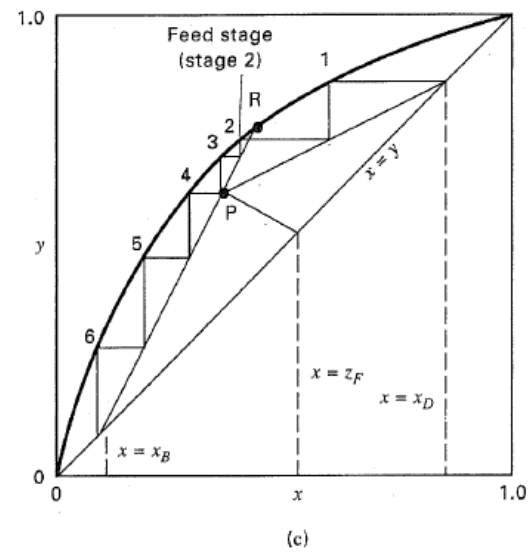
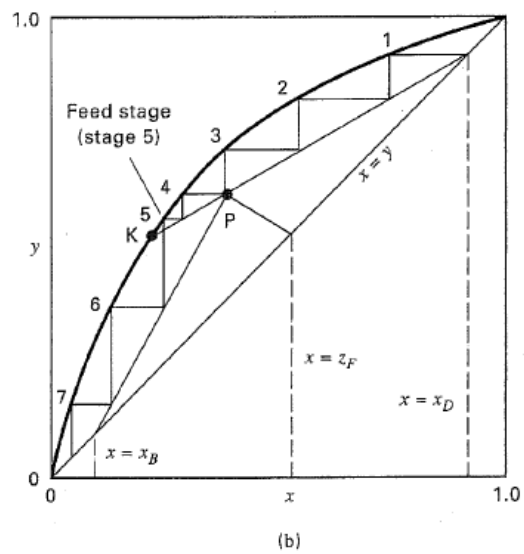
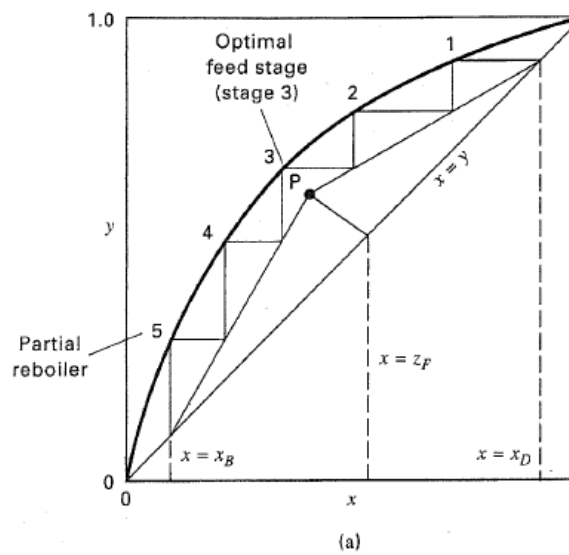


[http://images.google.com/imgres?imgurl=http://content.answers.com/main/content/wp/en-commons/0/08/Continuous\\_Fractional\\_Distillation.PNG&imgrefurl=http://www.answers.com/topic/continuous-distillation&h=490&w=300&sz=11&hl=en&start=76&um=1&tbid=pvidakSTv9XB1M:&tbnh=130&tbnw=80&prev=/images%3Fq%3Ddistillation%2Bsolvents%2Bimages%26start%3D72%26ndsp%3D18%26um%3D1%26hl%3Den%26rls%3DGGLJ,GGLJ:2006-43,GGLJ:en%26sa%3DN](http://images.google.com/imgres?imgurl=http://content.answers.com/main/content/wp/en-commons/0/08/Continuous_Fractional_Distillation.PNG&imgrefurl=http://www.answers.com/topic/continuous-distillation&h=490&w=300&sz=11&hl=en&start=76&um=1&tbid=pvidakSTv9XB1M:&tbnh=130&tbnw=80&prev=/images%3Fq%3Ddistillation%2Bsolvents%2Bimages%26start%3D72%26ndsp%3D18%26um%3D1%26hl%3Den%26rls%3DGGLJ,GGLJ:2006-43,GGLJ:en%26sa%3DN)

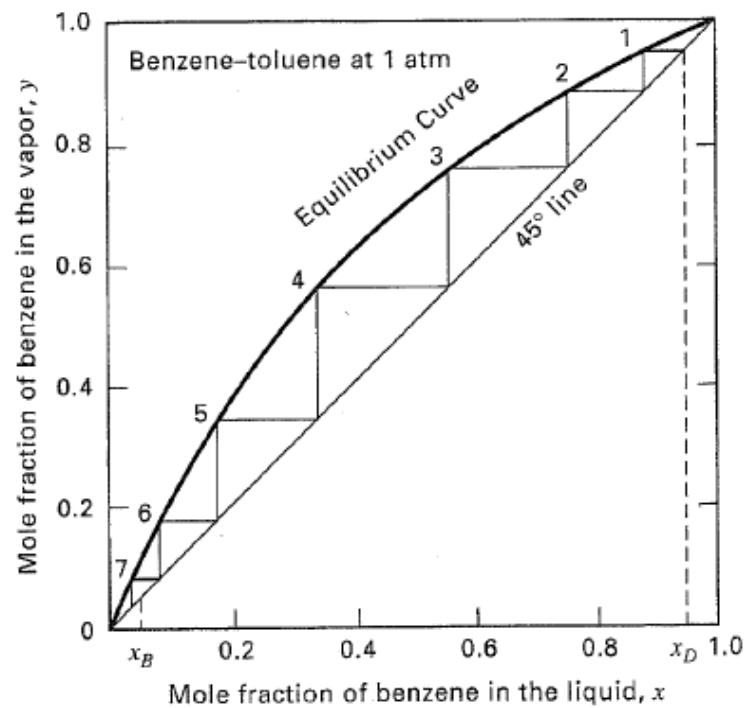


**Figure 7.4** Construction lines for McCabe–Thiele method.

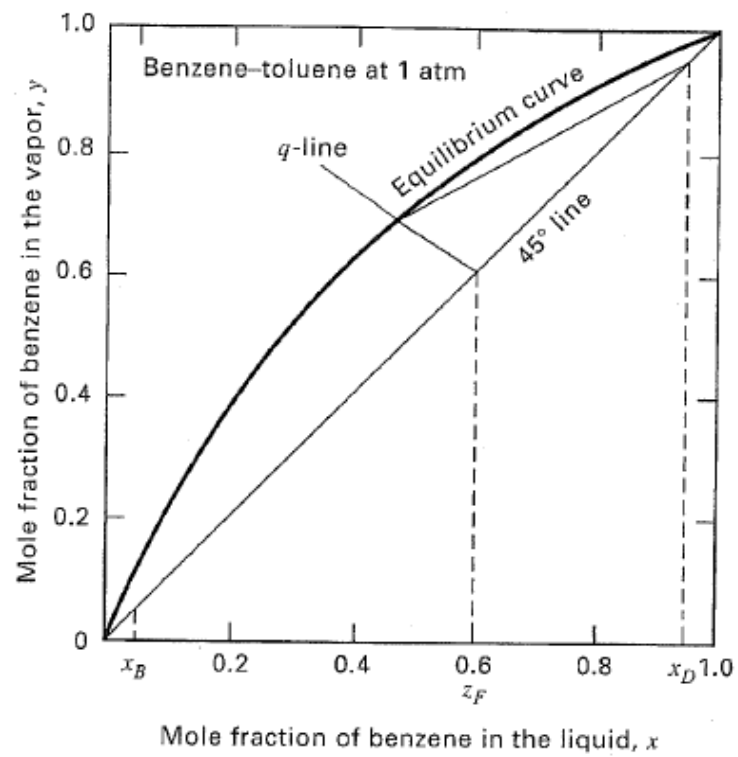




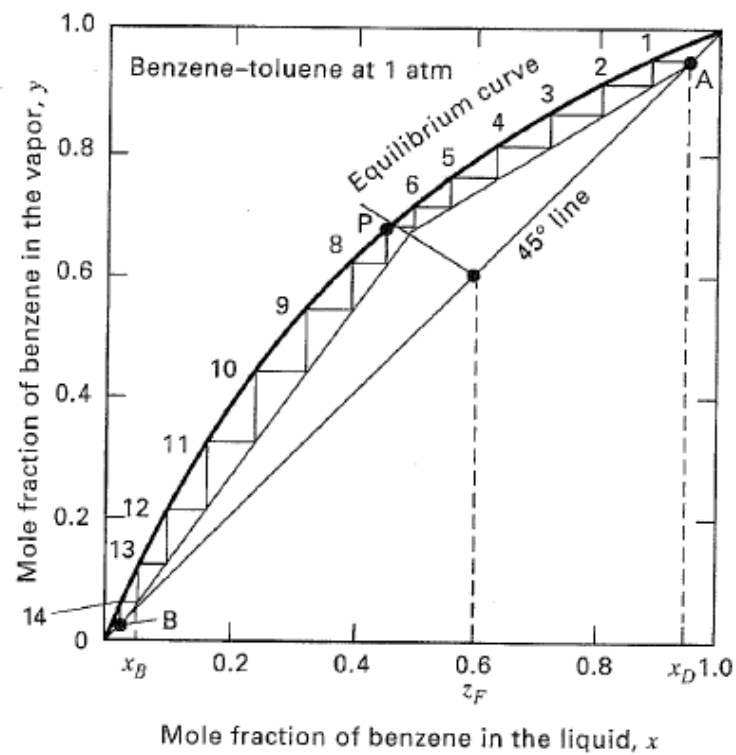




**Figure 7.13** Determination of minimum stages for Example 7.1.



**Figure 7.14** Determination of minimum reflux for Example 7.1.



**Figure 7.15** Determination of number of equilibrium stages and feed-stage location for Example 7.1.

**Table 7.2** Specifications for and Results from the McCabe–Thiele Method for Binary Distillation

Specifications	
$F$	Total feed rate
$z_F$	Mole-fraction composition of the feed
$P$	Column operating pressure (assumed uniform throughout the column)
	Phase condition of the feed at column pressure
	Vapor–liquid equilibrium curve for the binary mixture at column pressure
	Type of overhead condenser (total or partial)
	Type of reboiler (usually partial)
$x_D$	Mole-fraction composition of the distillate
$x_B$	Mole-fraction composition of the bottoms
$R/R_{\min}$	Ratio of reflux to minimum reflux
Results	
$D$	Distillate flow rate
$B$	Bottoms flow rate
$N_{\min}$	Minimum number of equilibrium stages
$R_{\min}$	Minimum reflux ratio, $L_{\min}/D$
$R$	Reflux ratio, $L/D$
$V_B$	Boilup ratio, $\bar{V}/B$
$N$	Number of equilibrium stages
	Optimal feed-stage location
	Stage vapor and liquid compositions

All mole fraction compositions are for the light key.