The Effect of Outlet Weir Height on Sieve Tray Performance

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Abstract

The effect of the outlet weir height on sieve tray performance is described in this paper. The studies were made to investigate the effect of the outlet weir height on sieve tray mass transfer efficiency and hydraulic performance. Tests were conducted in the 1.22 m diameter section of the Fractionation Research, Inc. (FRI) low-pressure column. Sieve trays with nominal hole areas of 14%, 13%, and 8% of the bubbling area and hole diameters of 12.7 mm were used. The weir heights used were 0, 25, 51, and 102 mm, with operating pressures ranging from deep vacuum with ortho/para xylene (o/p Xylene) at approximately 20 mmHg absolute to 11.38 bar with iso-butane/n-butane (iC_4/nC_4). A third system, cyclo-hexane/n-heptane (C_6/C_7) at 0.276 bar and 1.65 bar was also used. Experimental results, including tray capacity, mass transfer efficiency, pressure drop, and entrainment are presented and discussed. The results indicate that the effect of weir height very much depends on the system properties and open area.

Key Words: Distillation, sieve tray, open area, weir height, capacity, efficiency, entrainment, pressure drop

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Introduction

Trays with downcomers have been widely used in petrochemical industries for many years. The performance of trays depends on the uniformity of the liquid flow and the vapor liquid contact on the tray. Vapor from tray below, flows through tray perforations, forming bubbles that go through the liquid that is flowing across the tray. At tray exit a dam, called an overflow or outlet weir, maintains a pool of liquid. In general, outlet weirs are segmental and can be extension of the inner section of segmental downcomer. The outlet weir height typically is 51 mm, this is the height that has been used in obtaining most of the FRI data with the trays with downcomer. In vacuum distillation, operating in the spray regime, typical weir height is 0 to 25 mm, while absorbers and strippers may use 102 mm weir height(1). FRI has tested trays with weir heights ranging from 0 to 150 mm. For weir heights exceeding 15% of the tray spacing, one must be aware of capacity decrease due to the reduction in the effective tray spacing(2).

Care must be taken in installation of weir, an out of level weir promotes uneven liquid flow over the tray deck, which is detrimental to the tray performance. An out of level weir is a source of vapor-liquid channeling. The accepted tolerance on weir height ranges from ±1.5 to ±3 mm(2). Adjustable outlet weirs, ranging from 25 to 51 mm, used in rare occasions to provide flexibility interchanging efficiency and capacity; these are fabricated from slotted bars that can be bolted to the edge of the segmental downcomer at various heights. However, the possibility of mal-distribution due to out of levelness after adjustments far outweighs the gain, and the practice is no longer recommended[2].

The weir length is an important design criterion that determines the weir loading. The length may range from 50 to 80 percent of column diameter. For 1-pass and split flow trays, it is recommended to use a weir length of 60 to 70% of the tray diameter, while for 2-pass trays, a length of 50 to 60% of the tray diameter is more appropriate[3]. It is a normal practice to design the weir length to achieve a crest height (i.e., height of liquid over the weir) of 6 to 12 mm. A reasonable design requires a weir loading of 18 $m^3/(h.m)$[4], with a minimum weir load of 2 and maximum of 60 $m^3/(h.m)$[5]. At low liquid loads, where maintaining the liquid crest height between 6 to 12 mm may be difficult, triangular notch or picket fence weirs are used[2].

Inlet weirs are used on occasions to have a more uniform liquid flow from under the downcomer to the tray active area. Inlet weirs provide a barrier to the high inertia liquid flowing under downcomer, reducing the hydraulic jump and weeping at the inlet section of the tray. However, at high liquid rates, the inlet weir may cause weeping by projecting the high momentum liquid[1]further downstream.

This paper intends to present experimental data measured in a commercial size column using a range of systems and pressures. The purpose of this work is not to compare the experimental data to those predicted by the current correlations available in the open literature. It is hoped that having accurate experimental data from a commercial scale unit, would enable the developers to improve the existing models for the sieve tray designs. **Figure 1** is a photograph of a typical sieve tray tested by FRI.

Experimental Equipment

Plant Description

Figure 2 shows the low-pressure column and the auxiliary support system of the FRI experimental unit, as was configured for the measurement of entrainment rate in these tests. The current FRI experimental unit consists of two commercial size distillation columns and their support systems. For most operation modes only one column is used. The 1.22 m inside diameter high-pressure column is 8.4 m tall from bottom head seam to the top flange and rated for pressures up to 37 bar. The low- pressure column is rated from deep vacuum to 11.4 bar and consists of two sections. The lower section is essentially identical to the high-pressure column but is topped with a 3.66 m tall transition zone. The upper section has a 2.44 m inside diameter and is 6.7 m tall. Each column has a flanged head and clean inner wall design, which allows installation of hardware at any location in the column. Sight windows are strategically located to provide visual observation points inside the column. Couplings are available every 152 mm along the shell, which permits temperatures and pressures to be measured and samples to be withdrawn. The description of the FRI experimental unit, the procedure for obtaining and analyzing these data have been detailed previously[6][7][8]. For tests included in this paper, the entrainment collection tray was only installed for the deep vacuum operations at approximately 20 mmHg with o/p Xylene system.

Tray Design

Figure 3 is a schematic drawing of the test tray, with 14% hole area over bubbling area, as was installed in the column. **Table 1** shows the design details of this tray that had three weir heights of 0, 51, and 102 mm. **Table 2** shows the dimensions for the 8% hole area tray, and **Table 3** includes the dimensions for the tray used in the deep vacuum operation for o/p Xylene at 20 mmHg system. Trays in **Table 1** and **Table 2** were used for cyclohexane/n-heptane (C_6/C_7) system at 0.276 and 1.65 bar, and isobutane/n-butane ($i$$C_4$/n$C_4$) system at 11.38 bar.

For the 14% hole area, nine trays with smooth side of hole facing the vapor flow with a weir height of 51 mm, and eight trays with the sharp edge facing the vapor flow with weir heights of 0 and 102 mm were used. The trays had a bubbling area of 74% of the column area. The hole diameter was 12.7 mm on 30.2 mm equilateral triangular centers. The downcomer was a stepped type with a 102 mm recess height above the tray deck. A seal pan 102 mm deep and 184 mm wide was used. The bottom of the downcomer was 6 mm above the tray deck. A hold down bar, 25 mm wide and 6 mm thick, at the outlet weir position was considered as a negligible weir height. The detail dimensions of this set of tray are in **Table 1.**

Table 2 displays the detail dimensions of the set of trays with 8% nominal hole area as percent of the bubbling area. A hold down bar 6 mm high and 25 mm wide at outlet weir location, was considered to be the 0 mm weir height. Ten trays for the outlet weir heights of 0 and 102 mm, and nine trays for the 51 mm weir height were installed in the column. In all cases, the sharp edge of 12.7 mm hole diameter on 38.1 mm equilateral centers holes were facing the vapor. Straight downcomers with 38 mm downcomer clearance and 940 mm chordal length were used with the 51 and 102 mm weir heights. A seal pan 184 mm wide with a depth of 102 mm, under a stepped downcomer with a 102 mm recess height and 6 mm deck clearance, was used with the 0 mm weir height. Additional details are in **Table 2**.

The deep vacuum studies were conducted using seven trays, with 13% hole area over the bubbling area, at 610 mm tray spacing, with 12.7 mm hole diameter on 30.2 mm equilateral triangular spacing, with the sharp side of holes facing the vapor flow. Weir heights of 0, 25, and 102 mm with a weir length of 762 mm were used. The small downcomer occupied about 5% of the column area. The top tray was used as an entrainment collection tray, and was identical to the other trays except there was no downcomer. A 102 mm thick demister was located about 1550 mm above the entrainment tray to return any residual entrainment from the vapor stream to the entrainment tray. Gravity flow was used to meter and conduct the entrainment liquid collected in a 102 mm recessed seal pan to the reflux accumulator. To ensure that no liquid is backed up in the withdrawal line, causing the entrainment tray flooding, a liquid level guage was installed in the line at the same elevation of the entrainment collection tray and was monitored during entrainment measurement runs. Rather than using a seal pan, as in the previous cases, for 0 mm weir height a 25 mm high inlet weir was installed at the downcomer opening. The column setup is shown in **Figure 2**, and the tray dimensions are given in **Table 3**. To measure mass transfer efficiency and the operating conditions, liquid samples were withdrawn from bottom of each downcomer as the outlet sample of the tray attached to the downcomer.

Test Mixtures and Test Procedures

Systems

The results for three different test systems are discussed in this paper. The pressure range was from high vacuum with o/p Xylene system at approximately 20 mmHg absolute to high pressure with iC_4/nC_4 at 11.38 bar pressure. The third system used in these tests is cyclohexane/n-heptane (C_6/C_7) at 0.276 and 1.65 bar. The average approximate physical properties for the systems tested at the indicated pressures are given in **Table 4**.

Capacity

Except for the high vacuum runs, the capacity runs were made at total reflux and several constant liquid rate loads. The maximum attainable rates under stable conditions, defined as incipient flood by FRI, were determined for sieve trays by procedure previously described(6).

Efficiency

All efficiency studies were conducted using the total reflux operation. To calculate the efficiency, liquid samples were withdrawn from the bottom of each downcomer. The analyzed liquid samples were the liquid composition at the outlet of the tray connected to the downcomer. The compositions were obtained using vapor phase chromatography for the o/p Xylene and the iC_4/nC_4 mixtures, and by refractive index for the C_6/C_7 mixture. The analysis were within 1% band width accuracy. The composition profiles for the trays were plotted in terms of log[x/(1-x)] versus the tray location. The overall tray efficiencies were calculated, after dropping the outlier points and smoothing the profiles. The Fenske-Underwood(9)equation was used to obtain the total reflux efficiency from

$$N_t = \frac{\log\left[\frac{x_T\left(1-x_B\right)}{x_B\left(1-x_T\right)}\right]}{\log\alpha}$$

And

$$E_o = N_t / N_a$$

Pressure Drop

Total reflux pressure drop were measured for single trays, as well as multiple trays in sections of the column. The sections included all the trays, top half, and the bottom half. The reported pressure drops, are measurements averaged per tray basis.

Entrainment

The entrainment rates were measured at total reflux and several constant liquid rates. The following standard procedure was followed to obtain the constant liquid load entrainment measurement:

1. For the specified liquid load, the vapor rate was increased incrementally till a high entrainment rate was observed.

2. The conditions in the column were held steady until equilibrium was reached, after which all the measurements and flow rates were recorded.
3. The procedure was repeated by decreasing the vapor rate in stepwise manner, obtaining the entrainment for each vapor rate with a fixed liquid load.

The intervals were selected in such a way to obtain three to five entrainment rates for a specified liquid load.

Results for 14% & 13% Hole Areas

Capacity

The effect of weir height on capacity of 14% hole area sieve trays with 0, 51, and 102 mm outlet weirs for C_6/C_7 at 0.276 and 1.65 bar and that for iC_4/nC_4 at 11.38 bar displayed in **Figures 4 – 6** respectively. From these results, no significant effect on the capacity of sieve tray with 14% hole area and 610 mm tray spacing is observed. One expects to have the 51 mm weir height capacity in between the 0 and 102 mm weir height capacity, but this was not the case specifically for C_6/C_7 at 0.276 bar. This difference may be attributed to the actual difference in the trays tested.

Efficiency

Figures 7 – 9 show the effect of outlet weir heights of 0, 51, and 102 mm on the efficiency of 14% sieve trays for C_6/C_7 at 0.276 and 1.65 bar and that for iC_4/nC_4 at 11.38 bar. For C_6/C_7 at both pressures the efficiency increases with the increase in the weir height. In general, for butane system, except at a capacity factor of 0.077 m/s and 51 mm weir height with the highest capacity, the weir height from 0 to 102 mm does not affect the efficiency of iC_4/nC_4 at 11.38 bar.

Figure 10 shows the effect of outlet weir heights of 0, 25, and 102 mm on overall tray efficiency of the 13% sieve tray with 25 mm holes with o/p Xylene at approximate 20 mmHg absolute pressure. The increase in outlet weir height to 102 mm resulted in increased tray efficiency, removal of the outlet weir resulted in decreased efficiency.

Pressure Drop

Figures 11 – 13 compare the tray pressure drop, at total reflux condition, of the 14% sieve trays for outlet weir heights of 0, 51, and 102 mm with C_6/C_7 at 0.276 and 1.65 bar and that with iC_4/nC_4 at 11.38 bar. As expected, the pressure drop per tray in all cases increases with an increase in the weir height

The effect of weir height on the total reflux tray pressure drop of 13% sieve tray at total reflux on o/p Xylene at 20 mmHg absolute pressure, with 0, 25, and 102 mm weir height, is displayed in **Figure 14**. The tray with the 0 mm weir exhibits the lowest pressure drop, while the tray with 102 mm weir had the heighest pressure drop.

The pressure drop per theoretical stage is shown in **Figure 15.** There is no essential difference among the three weir heights.

Entrainment

Figure 16 shows the entrainment characteristics of the 13% hole area sieve tray having 0, 25, and 102 mm high outlet weirs with the o/p Xylene system at approximately 20 mmHg absolute. It can be observed that the trays with 0 and 102 mm outlet weirs had about the same entrainment characteristics, while the tray with 25 mm outlet weir had an abnormally high entrainment rate. This may be attributed to the operating pressure difference between the two sets of trays, with the test of the tray with 25 mm weir being conducted at 16 mmHg, and for 0 and 102 mm weir height at 20 mmHg.

There are conflicting views on the effect of liquid load on entrainment in the literature. Various researchers have found that increasing the liquid load either increases entrainment[10, 11], decreases entrainment[12], or both[13, 14]. The effect of weir height with the constant liquid load of 18 and 25 $m^3/(h.m)$ on entrainment are shown in **Figures 17** and **18**.

Results for 8% Hole Area

Capacity

Figures 19 – 21 show the effect of weir height on capacity of 8% hole area sieve trays with 0, 51, and 102 mm high outlet weirs for C_6/C_7 at 0.276 and 1.65 bar and that for iC_4/nC_4 at 11.38 bar. For C_6/C_7 at 0.276 and 1.65 bar, **Figures 19** and **20**, no significant difference in capacity was observed between the 0, 51, and 102 mm weirs at any liquid rate. For butane system at 11.38 bar pressure, **Figure 21**, there was little difference in capacity for the 0 and 51 mm weirs. The 102 mm outlet weirs reduced the capacity for the system at very high liquid rate.

Efficiency

In **Figures 22 - 24**, the overall tray efficiencies for three weir heights are compared. For C_6/C_7 system at 0.276 bar pressure, **Figure 22**, the 0 mm outlet weir was more efficient at low vapor rates than were the higher weirs. For 1.65 bar pressure C_6/C_7 system, **Figure 23**, the weir height had only small effect on the efficiency.

For the butane system, **Figure 24**, the highest efficiency was obtained with the 51 mm weir, while the lowest efficiency was obtained with 0 mm weir. However, there are indication from additional tests of this tray that the seal pan were not properly installed and excessive leakage was responsible for the low efficiency of the butane system.

Pressure Drop

The effect of weir height on total reflux pressure drop measurements are shown in **Figure 25** for C_6/C_7 system at 0.276 bar and in **Figure 26** and for 1.65 bar, and in **Figure 27** for butane system at 11.38 bar. All these figures indicate, the contribution of weir height to tray pressure drop is a function of vapor rate. The contribution is the highest at low vapor rate, becoming negligible at higher vapor rates.

Conclusions

Performance characteristics of a sieve tray with 12.7 mm holes, weir heights ranging from 0 to 102 mm, with three nominal hole areas of 14%, 13%, and 8% of bubbling area, with systems that cover a wide range of properties have been obtained in a large scale commercial installation. Although the results from these studies are not typical of all sieve tray designs, certain findings such as the effect of system properties, liquid loadings, and weir height on capacity, efficiency, pressure drop, and entrainment can be important to hardware design and optimum operating conditions.

The results are summarized below:

1. Weir heights of 0 to 102 mm have no significant effect on the capacity of the sieve trays with hole area of 8% or greater at tray spacing of 610 mm.
2. The effect of weir height on the efficiency of sieve tray is not conclusive. The following results were obtained from these studies with 14% hole area tray:

System	Comparative Performance of 0, 51, and 102 mm Weirs
C_6/C_7, 0.276 bar	Efficiency increases with weir height

System	Comparative Performance of 0, 51, and 102 mm Weirs
C_6/C_7, 1.65 bar	Efficiency increases with weir height
iC_4/nC_4, 11.38 bar	Highest efficiency with 51 mm weirs, 0 and 102 mm same

In contrast, the results on an 8% sieve tray were as follows:

System	Comparative Performance of 0, 51, and 102 mm Weirs
C_6/C_7, 0.276 bar	Efficiency about the same with all three
C_6/C_7, 1.65 bar	Highest efficiency with 0 mm weirs, 51 and 102 mm same
iC_4/nC_4, 11.38 bar	Highest efficiency with 51 mm weirs, 0 and 102 mm same

These results suggest that the effects of weir height are functions of system properties and hole area.

Nomenclature

C_b = superficial capacity factor based on tray bubbling area, (m/s)
C_6 = ciclo-hexane
C_7 = normal heptanes
iC_4 = iso-butane
nC_4 = normal butane
E_o = overall tray efficiency
N_a = actual number of trays
N_t = theoretical number of trays
o/p = ortho/para
x = mole fraction of more volatile component in liquid phase

x_B = mole fraction of more volatile component in liquid phase at bottom of section of trays
x_T = mole fraction of more volatile component in liquid phase at top of section of trays

Greek Letters
α = relative volatility

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Table 1. Design Detail of Trays with 14% Hole Area

Column Diameter, mm	1213
Tray Spacing, mm	610
Perforated Sheet, Material	316 SS
Perforated Sheet, Thickness, mm	1.59
Outlet Weir Length, mm	940
Outlet Weir Height, mm	0^*, 51, 102
Clearance under Downcomer, mm	$6^!$,19.1
Effective Bubbling Area, m^2	0.860
Nominal Downcomer Area at Top, m^2	0.107
Nominal Downcomer Area at Bottom, m^2	$0.049^{!!}$, 0.107
Hole Diameter and Spacing, mm x mm	12.7 x 30.2
Number of Holes per Tray	930
Nominal Hole Area, % Bubbling Area	14
Hole Area, m^2	0.118
Edge of Hole Facing Vapor Flow	Sharp**

*6 mm Hold Down Bar
! Distance above a 184 mm x 101 mm Seal Pan
!! Stepped Downcomer with 101 mm Recess
**For 51 mm Weir Height Smooth edge was used

Table 2. Design Detail of Trays with 8% Hole Area

Column Diameter, mm	1213
Tray Spacing, mm	610
Perforated Sheet, Material	316 SS
Perforated Sheet, Thickness, mm	1.59
Outlet Weir Length, mm	940
Outlet Weir Height, mm	0^*, 51, 102
Clearance under Downcomer, mm	$6^!$,19.1
Effective Bubbling Area, m^2	0.860
Nominal Downcomer Area at Top, m^2	0.107
Nominal Downcomer Area at Bottom, m^2	$0.049^{!!}$, 0.107
Hole Diameter and Spacing, mm x mm	12.7 x 38.1
Number of Holes per Tray	565
Nominal Hole Area, % Bubbling Area	8
Hole Area, m^2	0.072
Edge of Hole Facing Vapor Flow	Sharp

*6 mm Hold Down Bar
! Distance above a 184 mm x 101 mm Seal Pan
!! Stepped Downcomer with 101 mm Recess Height

Table 3. Design Detail of Trays for Deep Vacuum Operation

Column Diameter, mm	1213
Tray Spacing, mm	610
Perforated Sheet, Material	316 SS
Perforated Sheet, Thickness, mm	1.59
Outlet Weir Length, mm	762
Outlet Weir Height, mm	0, 25, 102
Inlet Weir Length, mm	762
Inlet Weir Height, mm	25*
Edge of Hole Facing Vapor Flow	Sharp
Downcomer Clearance, mm	19.1
Effective Bubbling Area, m^2	1.041
Nominal Downcomer Area at Top, m^2	0.049
Nominal Downcomer Area at Bottom, m^2	0.049
Hole Diameter and Spacing, mm x mm	12.7 x 30.2
Number of Holes per Tray	1066
Nominal Hole Area, % Bubbling Area	13
Hole Area, m^2	0.135

*For 0 mm Outlet Weir studies

Table 4. Average Physical Properties of the Test Systems under Operating Conditions

System						
	Unit	Cyclo-hexane/n-Heptane			o/p Xylene	Iso-butane/n-Butane
Pressure	bar	0.276	0.35	1.65		11.38
	mm Hg				16 - 20	
Vapor Density	kg/m^3	1.210	1.128	5.032	0.124	28.27
Liquid Density	kg/m^3	707.9	705.6	659.1	845.6	493.4
Liquid Viscosity	mPa/s	0.43	0.41	.25	.52	0.091
Surface Tension	mN/m	19.4	19.1	14.2	26.4	5.27
Relative Volatility		1.82	1.81	1.57	1.29	1.24

Figure 1. 14% Hole Area Commercial Sieve Tray

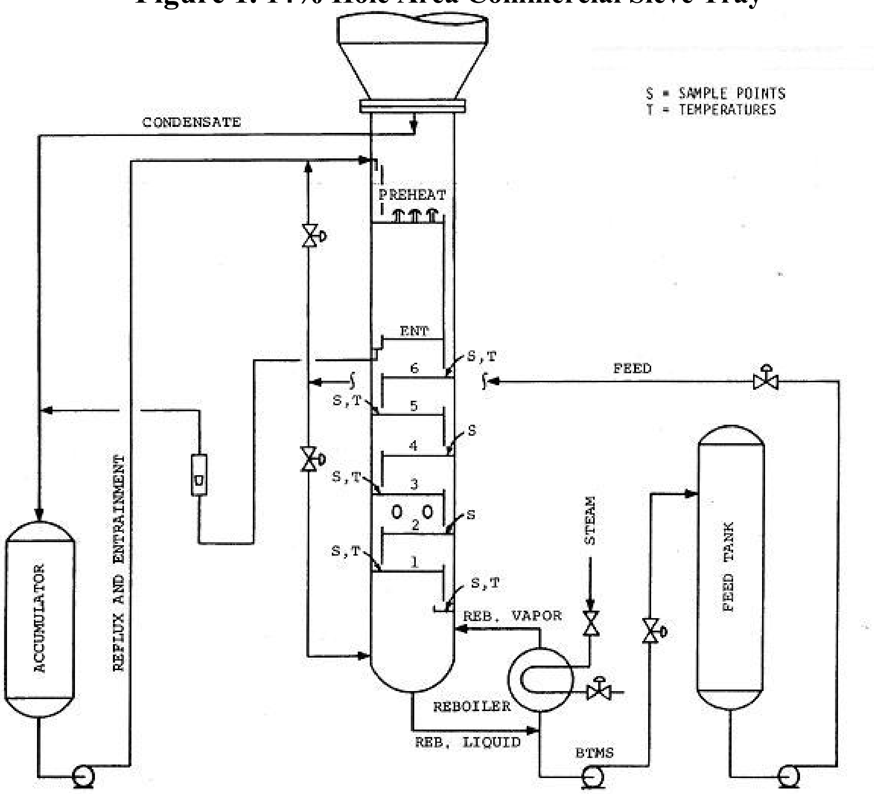

Figure 2. FRI Distillation Unit Setup with Entrainment Capture Tray

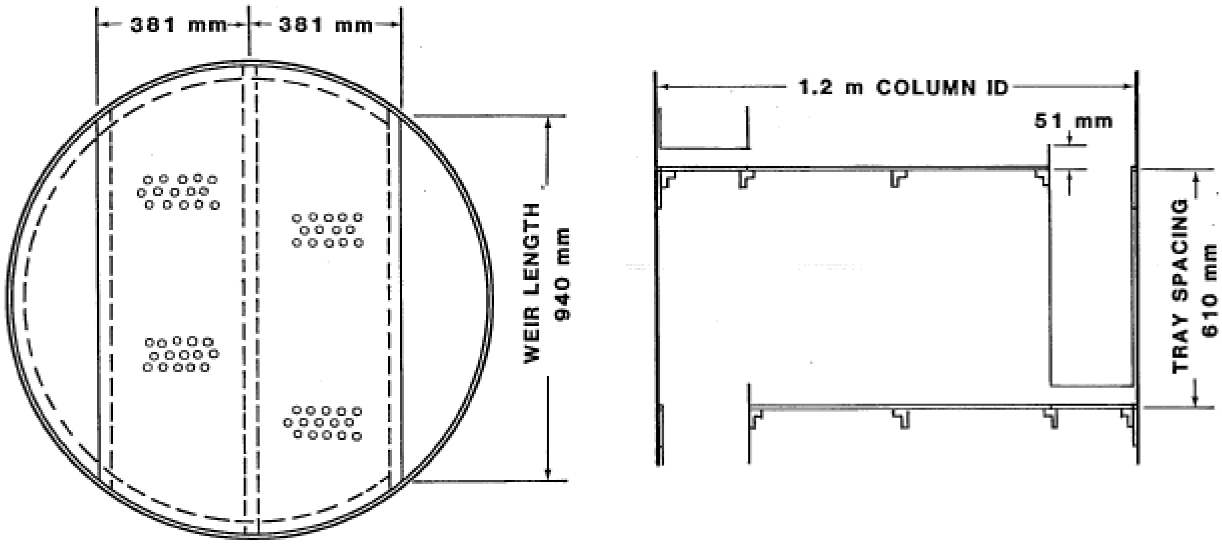

Figure 3. Diagram of Test tray with 14% Hole Area

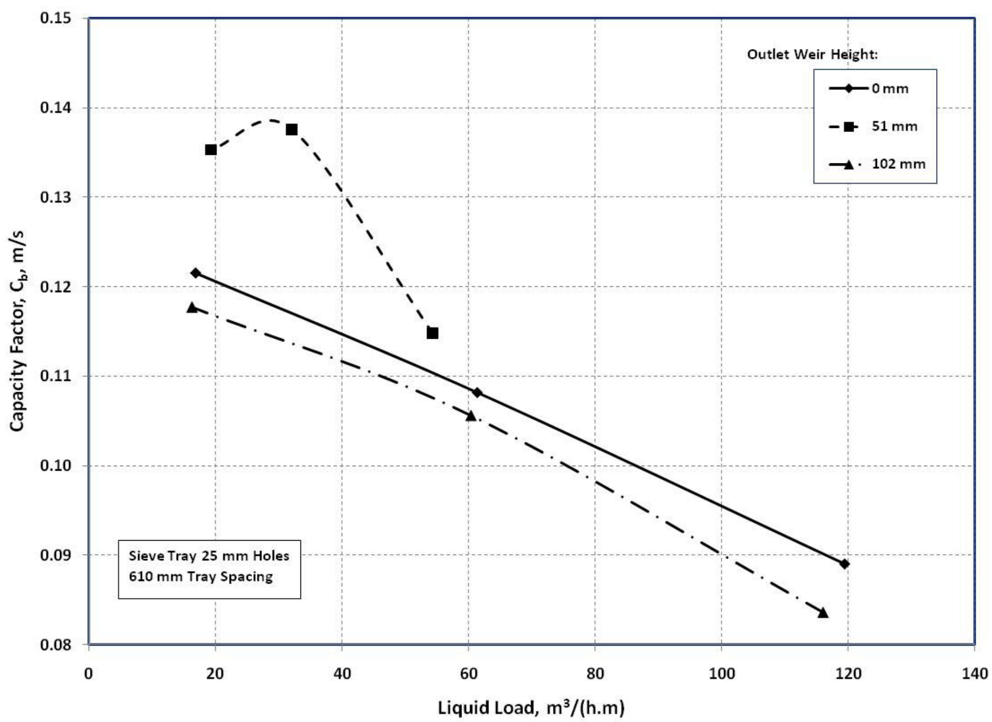

Figure 4. Effect of Weir Height on Capacity for 14% Hole Area Tray (C_6/C_7 at 0.276 bar Pressure)

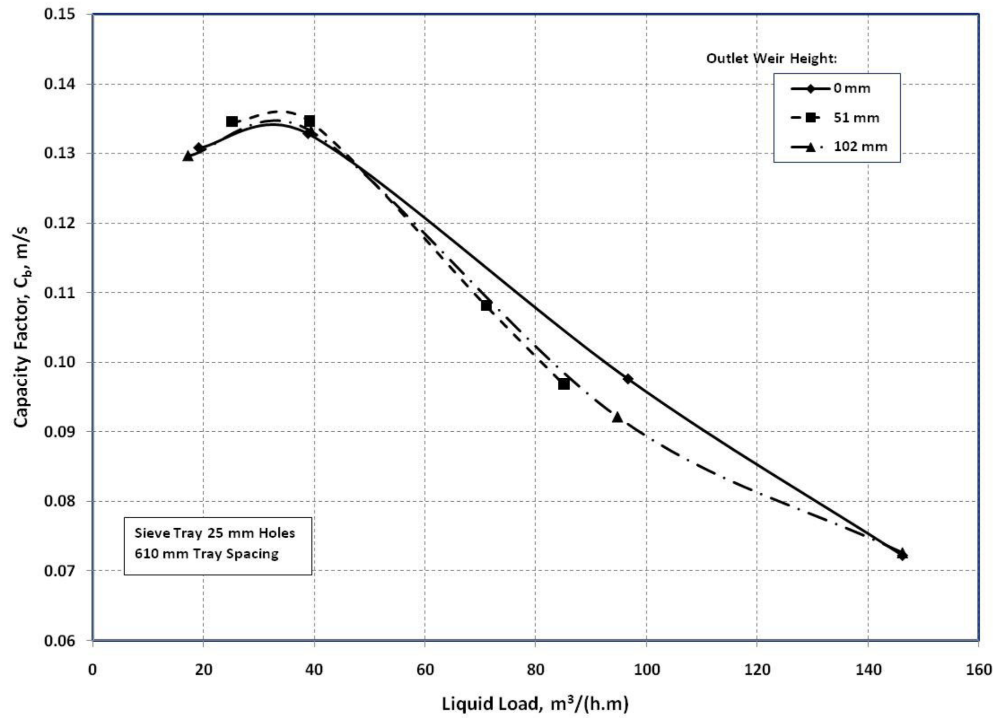

Figure 5. Effect of Weir Height on Capacity for 14% Hole Area Tray (C_6/C_7 at 1.65 bar Pressure)

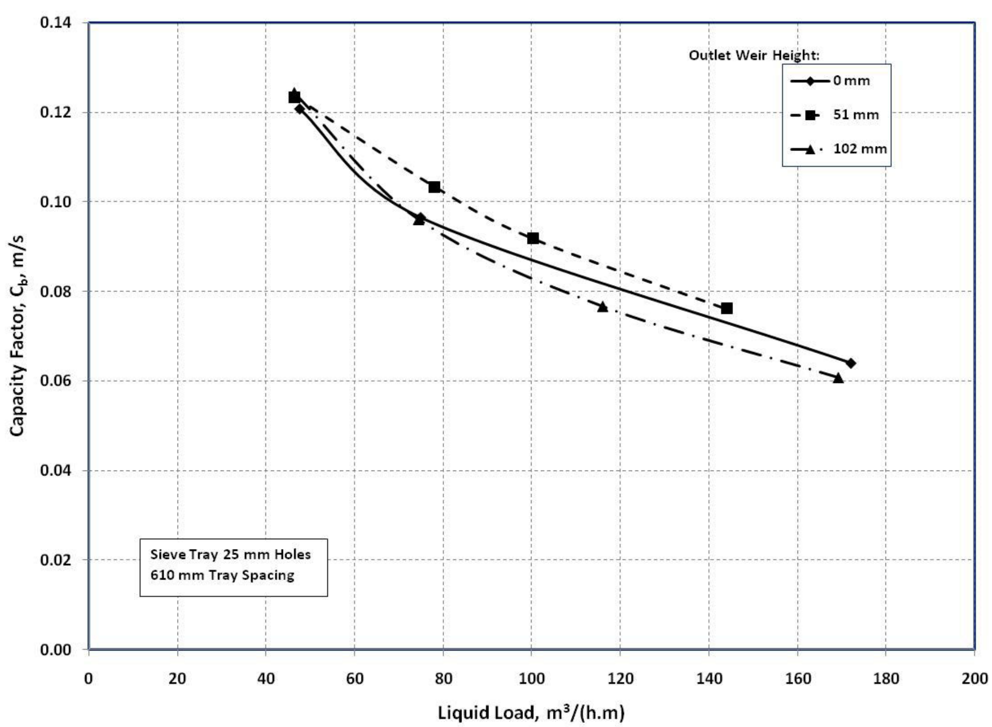

Figure 6. Effect of Weir Height on Capacity for 14% Hole Area Tray (iC_4/nC_4 at 11.38 bar Pressure)

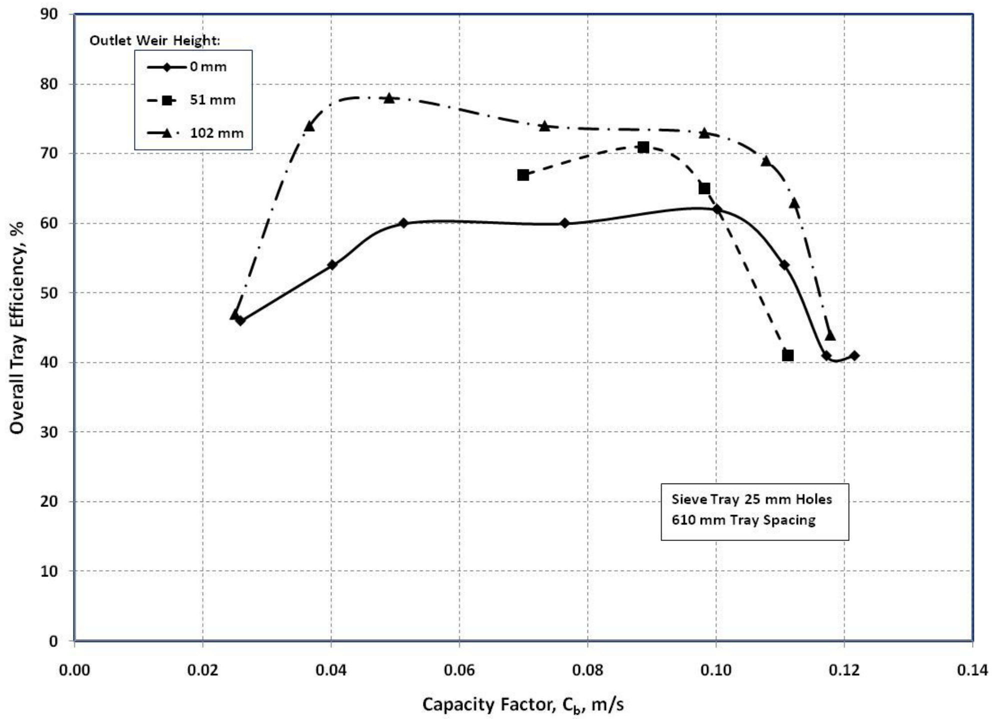

Figure 7. Effect of Weir Height on Efficiency for 14% Hole Area Tray (C_6/C_7 at 0.276 bar Pressure)

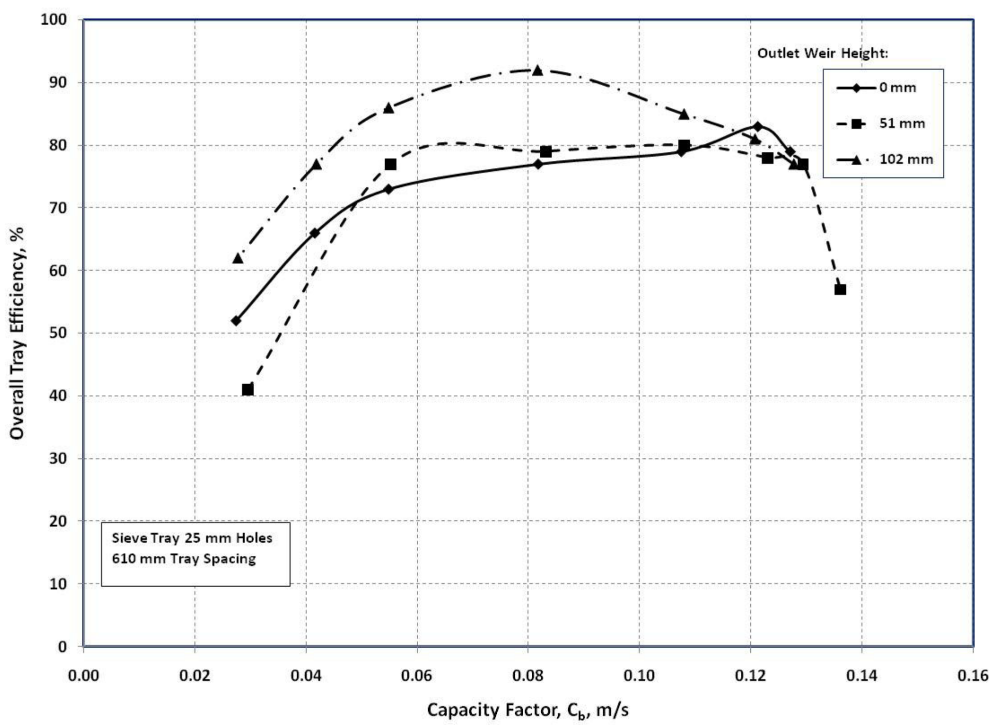

Figure 8. Effect of Weir Height on Efficiency for 14% Hole Area Tray (C_6/C_7 at 1.65 bar Pressure)

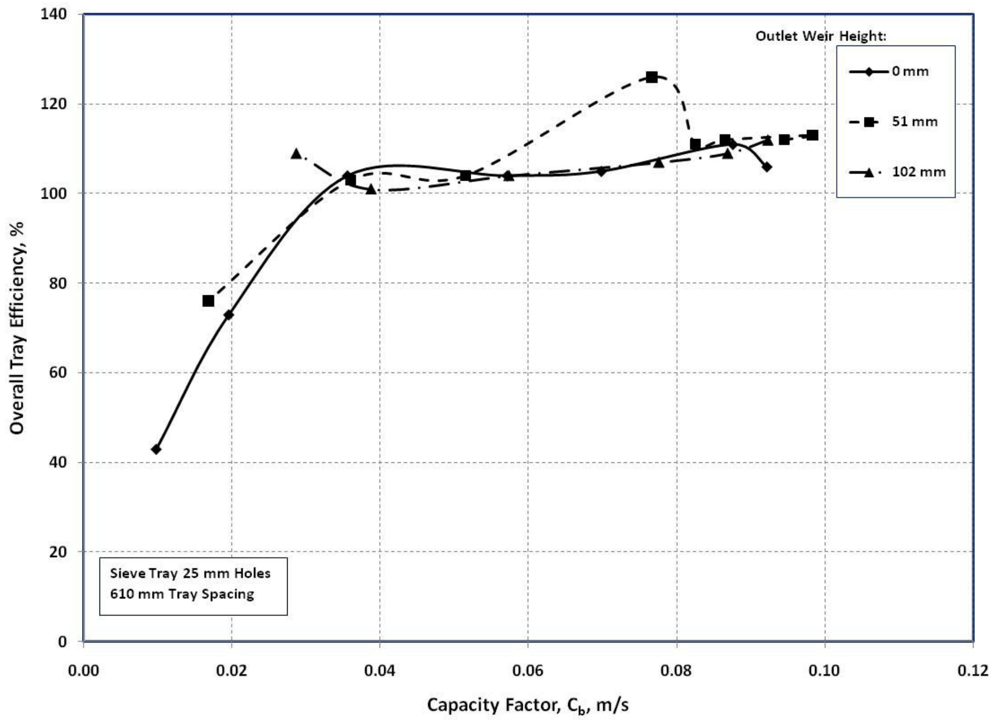

Figure 9. Effect of Weir Height on Efficiency for 14% Hole Area Tray (iC_4/nC_4 at 11.38 bar Pressure)

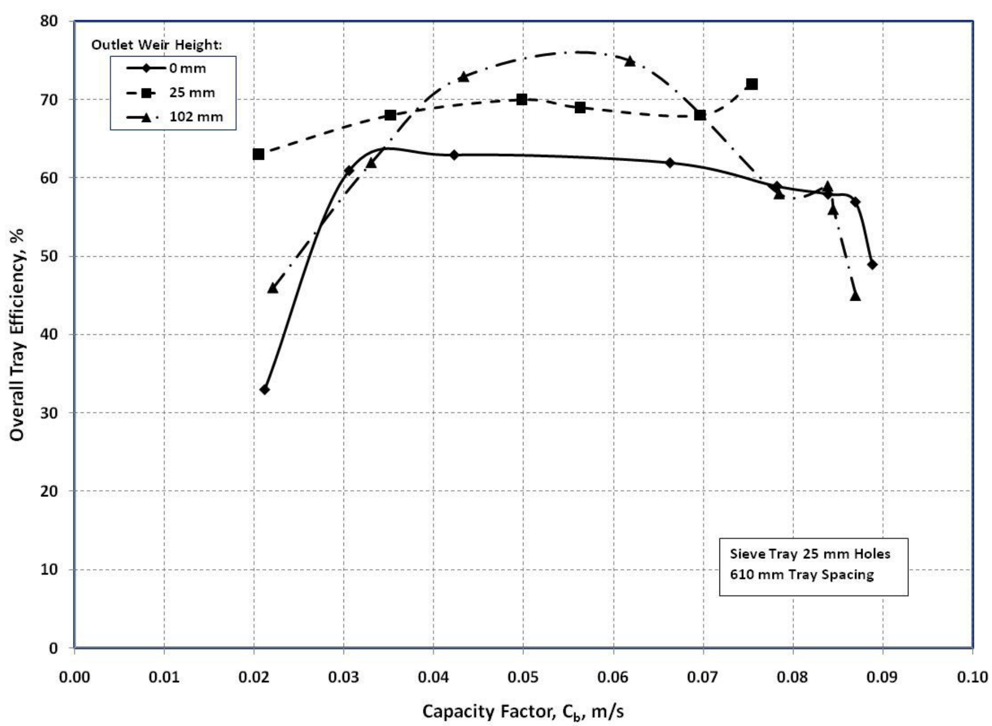

Figure 10. Weir Height Effect on Efficiency with 13% Hole Area Tray (o/p Xylene at 20 mmHg Absolute Pressure)

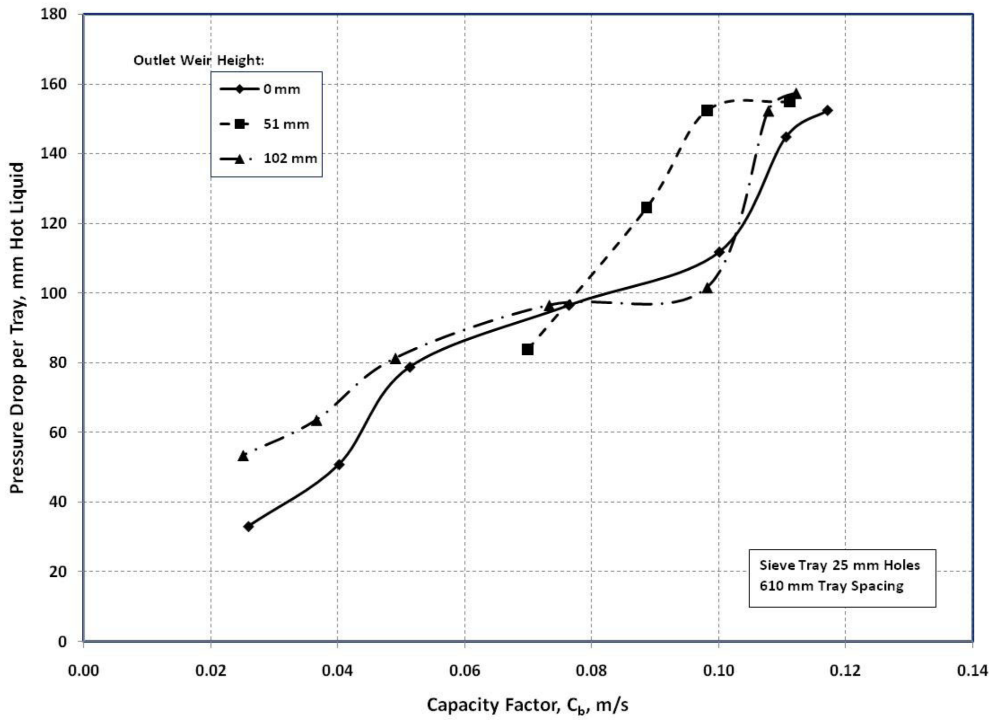

Figure 11. Effect of Weir Height on Pressure Drop for 14% Hole Area Tray (C_6/C_7 at 0.276 bar Pressure)

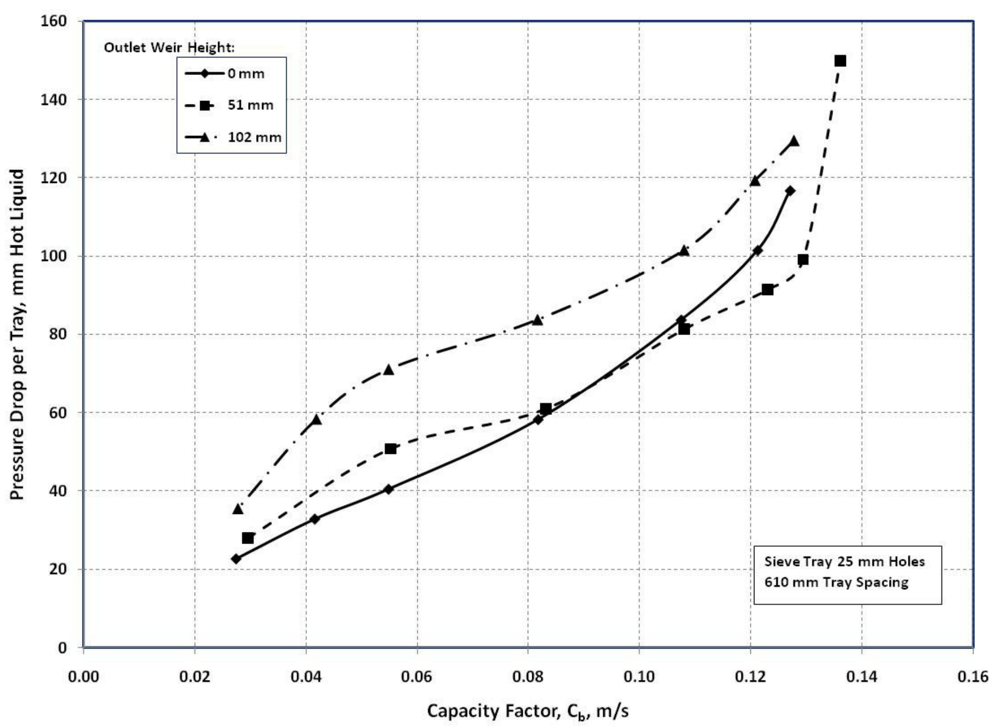

Figure 12. Effect of Weir Height on Pressure Drop for 14% Hole Area Tray (C_6/C_7 at 1.65 bar Pressure)

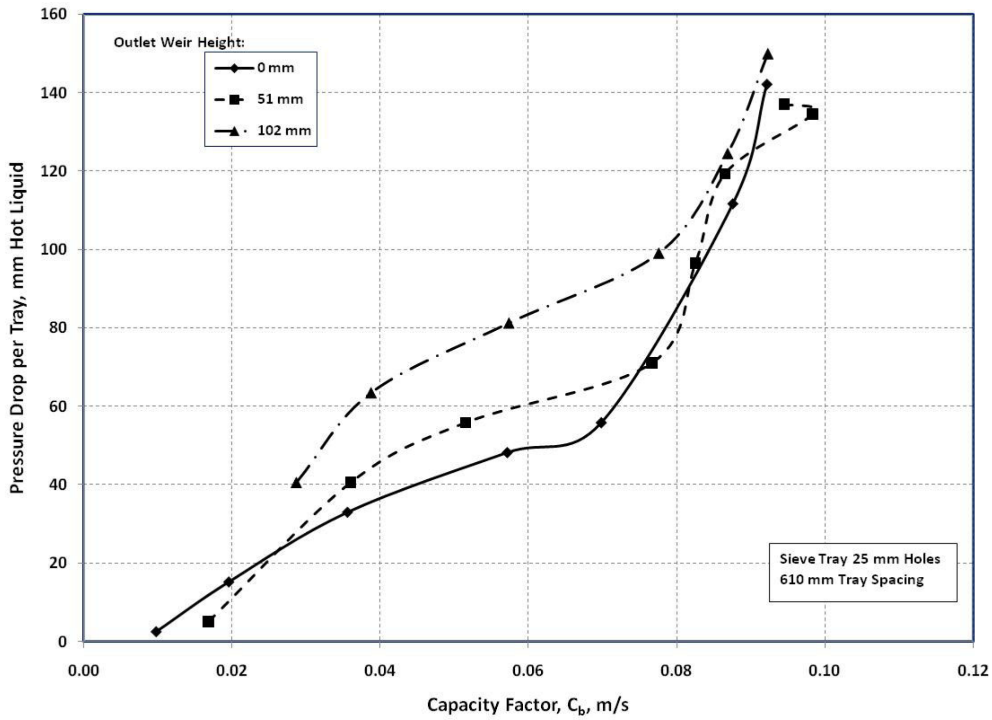

Figure 13. Effect of Weir Height on Pressure Drop for 14% Hole Area Tray (iC_4/nC_4 at 11.38 bar Pressure)

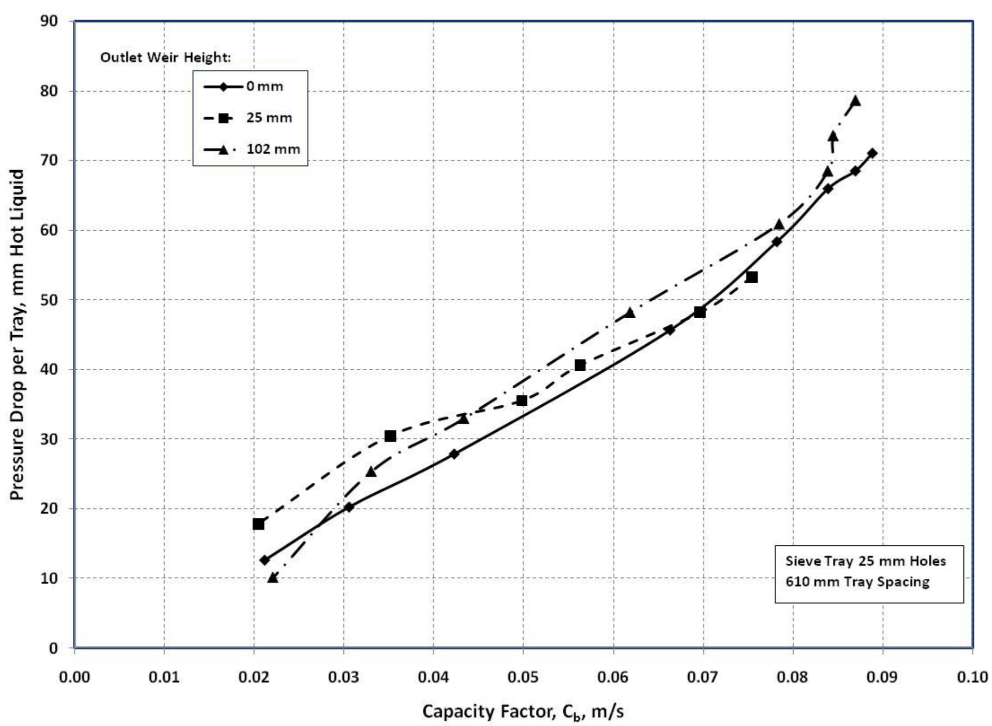

Figure 14. Effect of Weir Height on Pressure Drop for 13% Hole Area Tray (o/p Xylene at 20 mmHg Absolute Pressure)

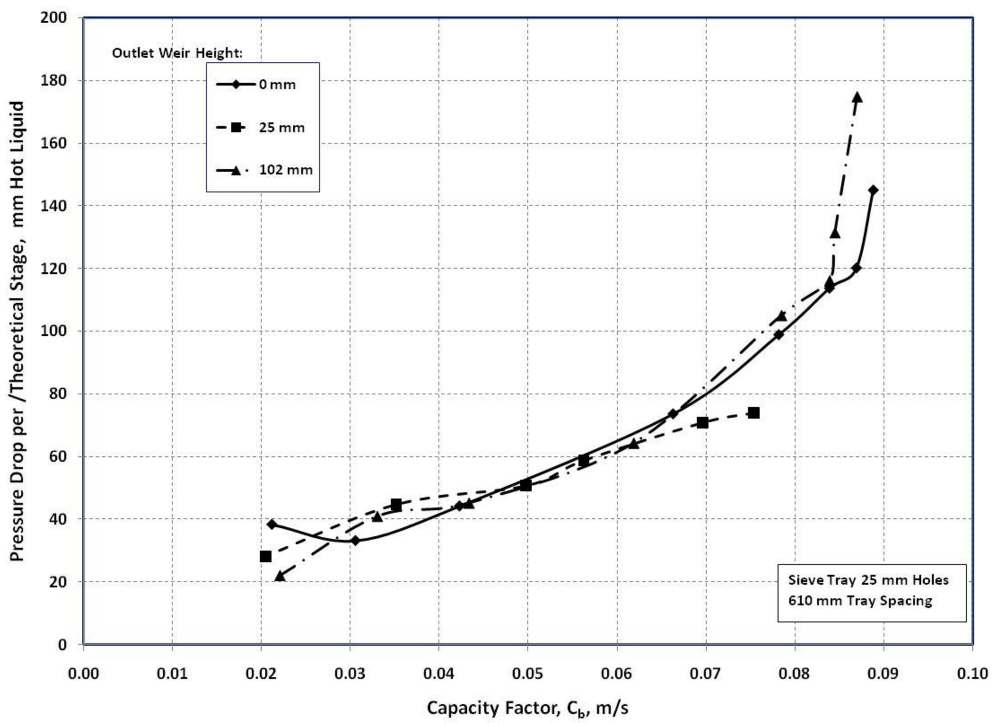

Figure 15. Effect of Weir Height on Pressure Drop per Stage for 13% Hole Area Tray (o/p Xylene at 20 mmHg Absolute Pressure)

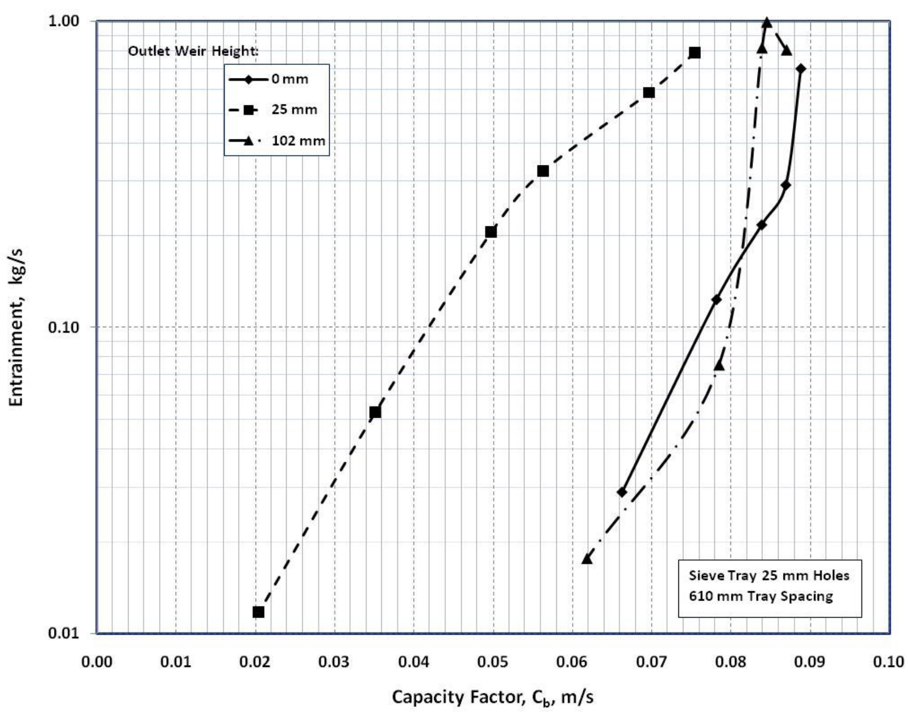

Figure 16. Effect of Weir Height on Total Reflux Entrainment 13% Hole Area Tray (o/p-Xylene at 20 mmHg Absolute Pressure)

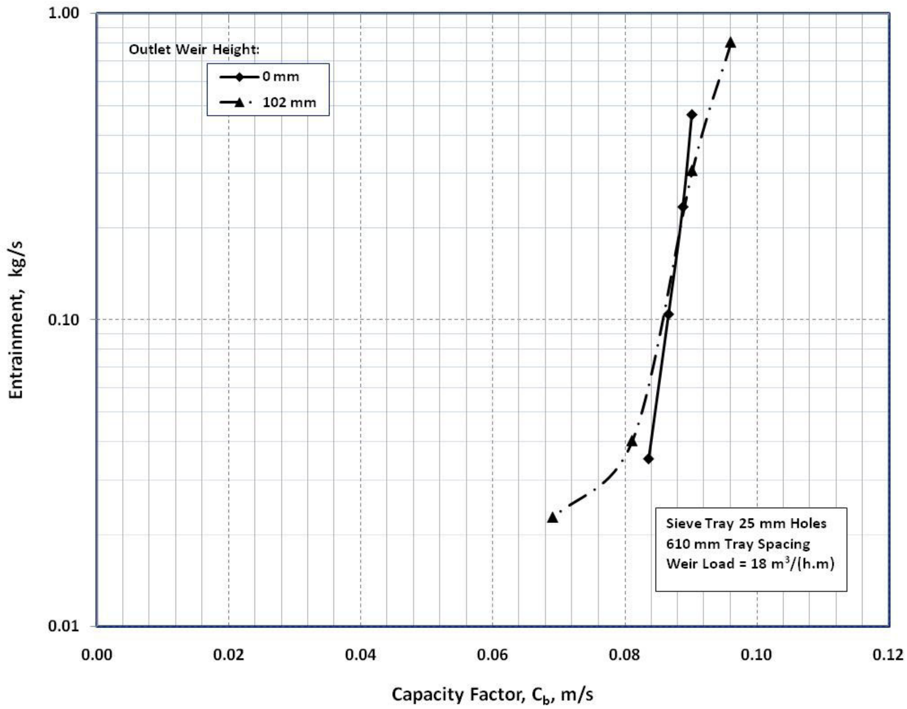

Figure 17. Constant Weir Load (18 $m^3/(h.m)$) Entrainment, 13% Hole Area Tray (o/p Xylene at 20 mmHg Absolute Pressure)

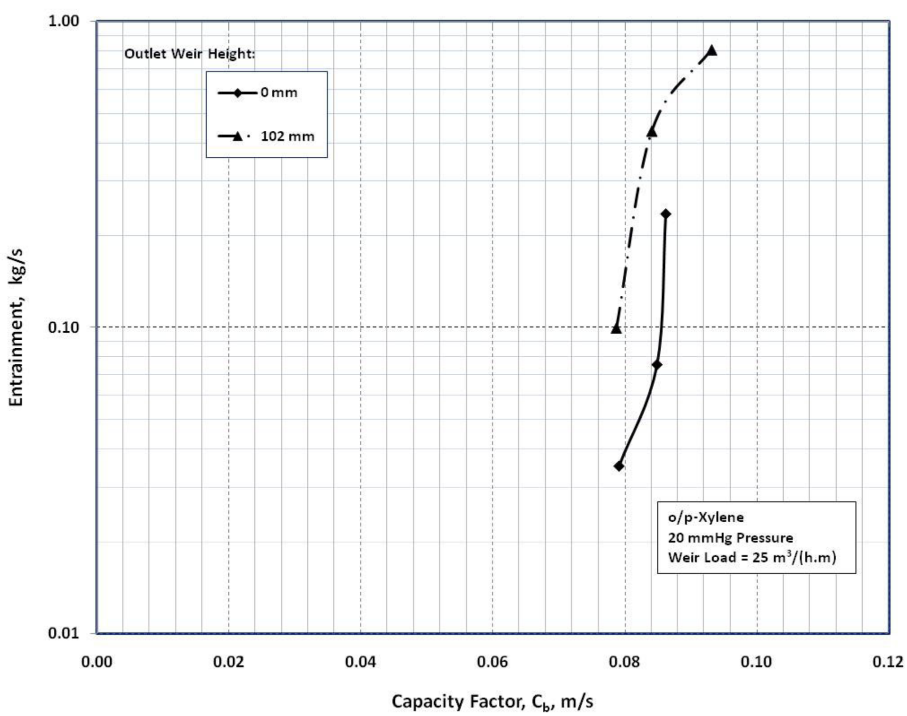

Figure 18. Constant Weir Load (25 $m^3/(h.m)$) Entrainment, 13% Hole Area Tray (o/p Xylene at 20 mmHg Absolute Pressure)

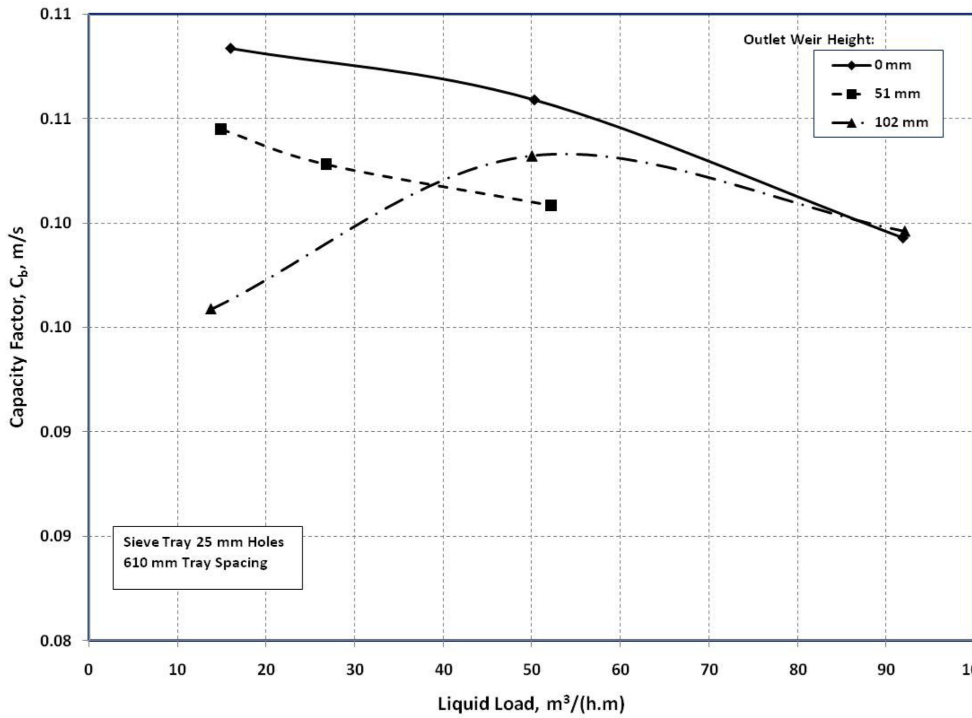

Figure 19. Figure Effect of Weir Height on Capacity for 8% Hole Area Tray (C_6/C_7 at 0.276 bar Pressure)

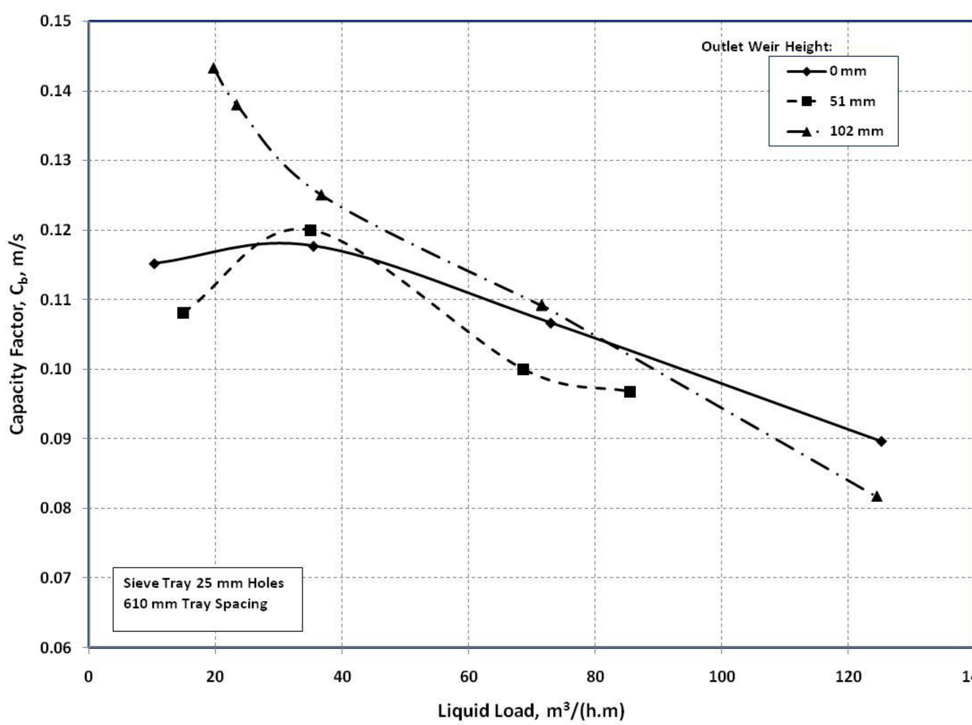

Figure 20. Effect of Weir Height on Capacity for 8% Hole Area Tray (C_6/C_7 at 1.65 bar Pressure)

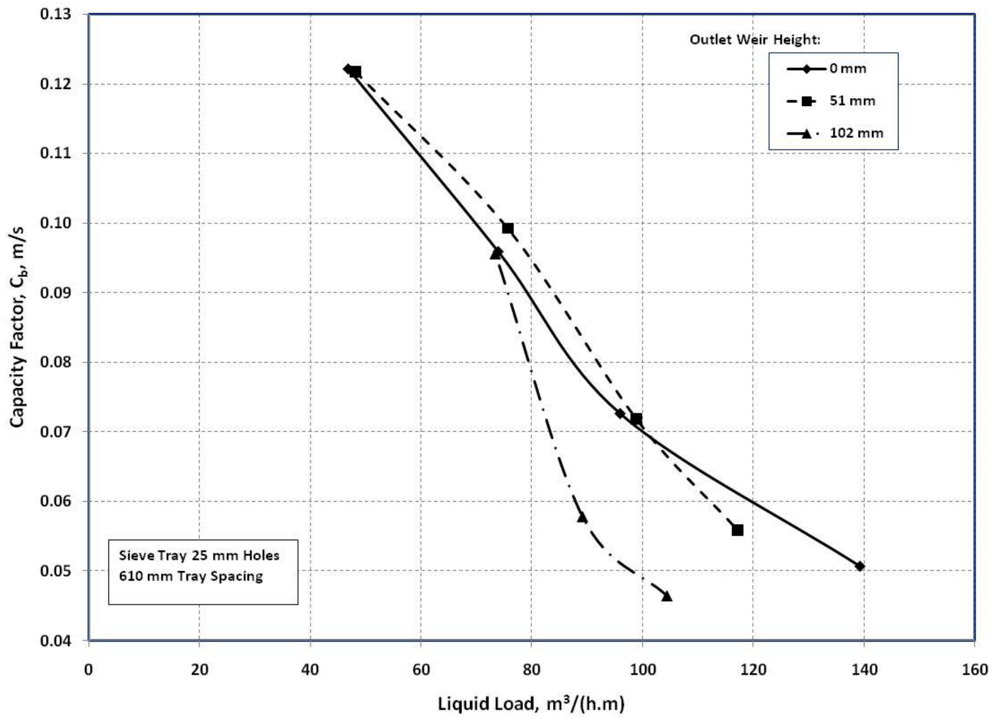

Figure 21. Effect of Weir Height on Capacity for 8% Hole Area Tray (iC_4/nC_4 at 11.38 bar Pressure)

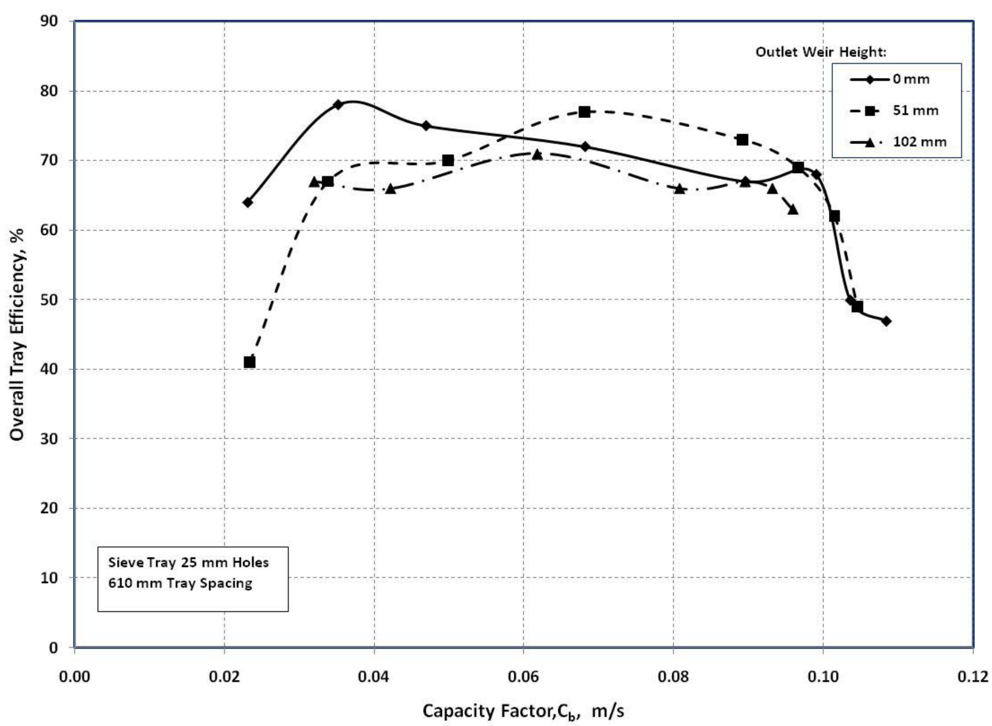

Figure 22. Effect of Weir Height on Efficiency for 8% Hole Area Tray (C_6/C_7 at 0.276 bar Pressure)

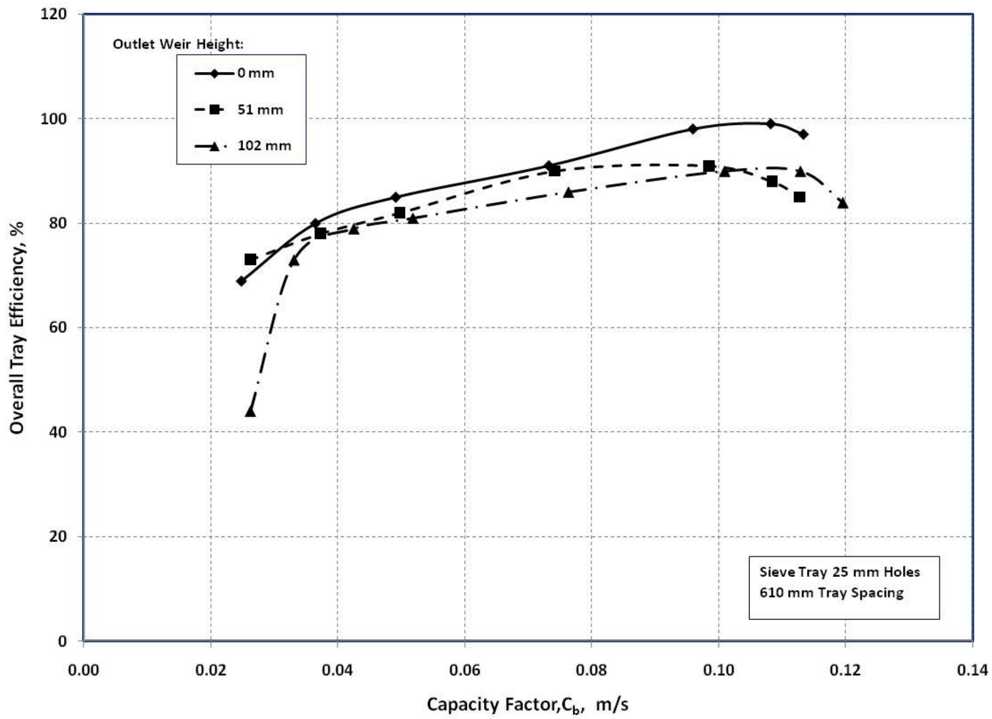

Figure 23. Effect of Weir Height on Efficiency for 8% Hole Area Tray (C_6/C_7 at 1.65 bar Pressure)

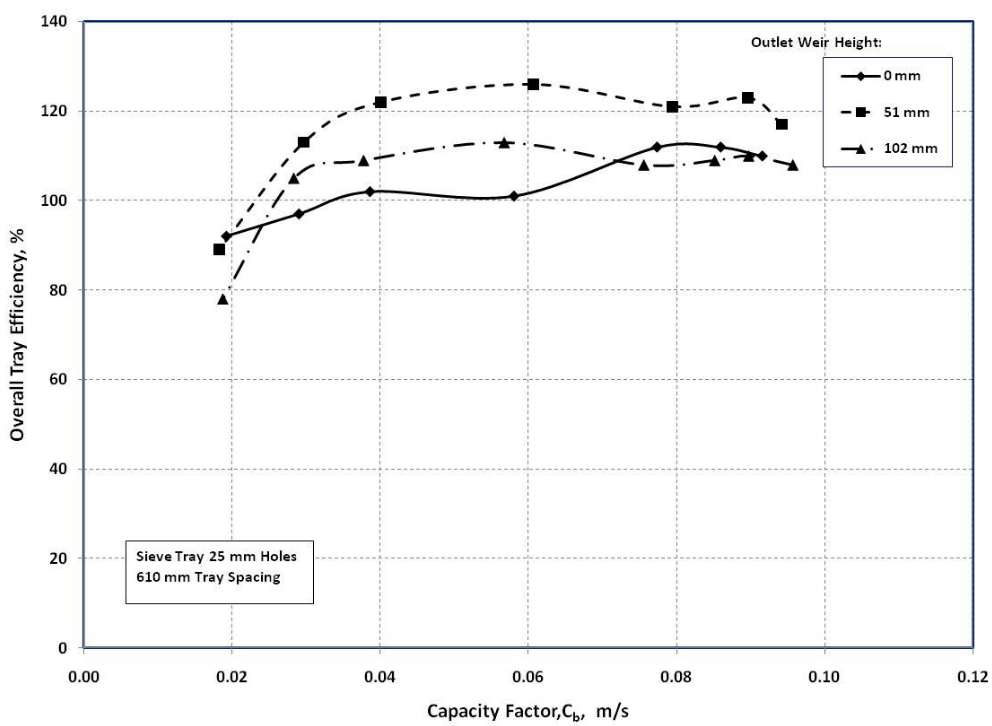

Figure 24. Effect of Weir Height on Efficiency for 8% Hole Area Tray (*i*C_4/nC_4 at 11.38 bar Pressure)

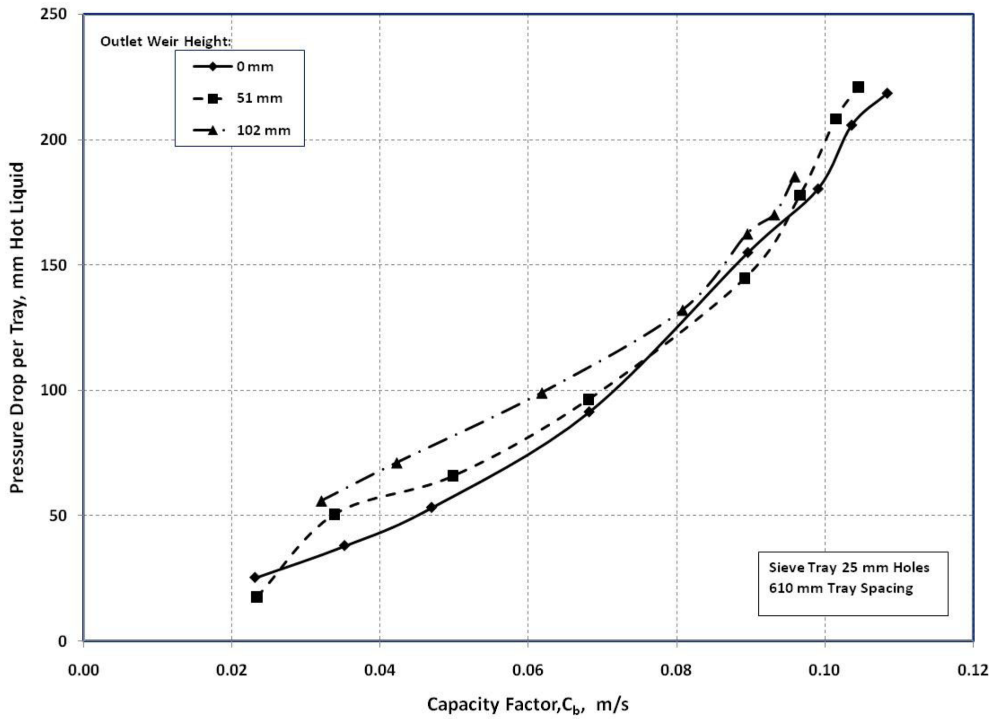

Figure 25. Effect of Weir Height on Pressure Drop for 8% Hole Area Tray (C_6/C_7 at 0.276 bar Pressure)

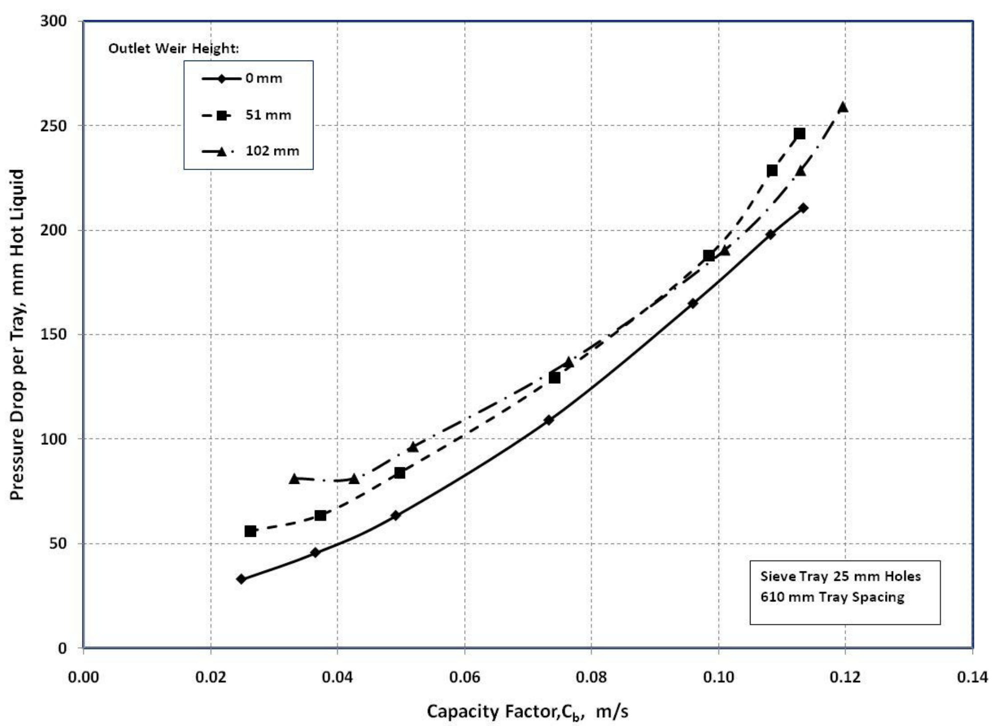

Figure 26. Effect of Weir Height on Pressure Drop for 8% Hole Area Tray (C_6/C_7 at 1.65 bar Pressure)

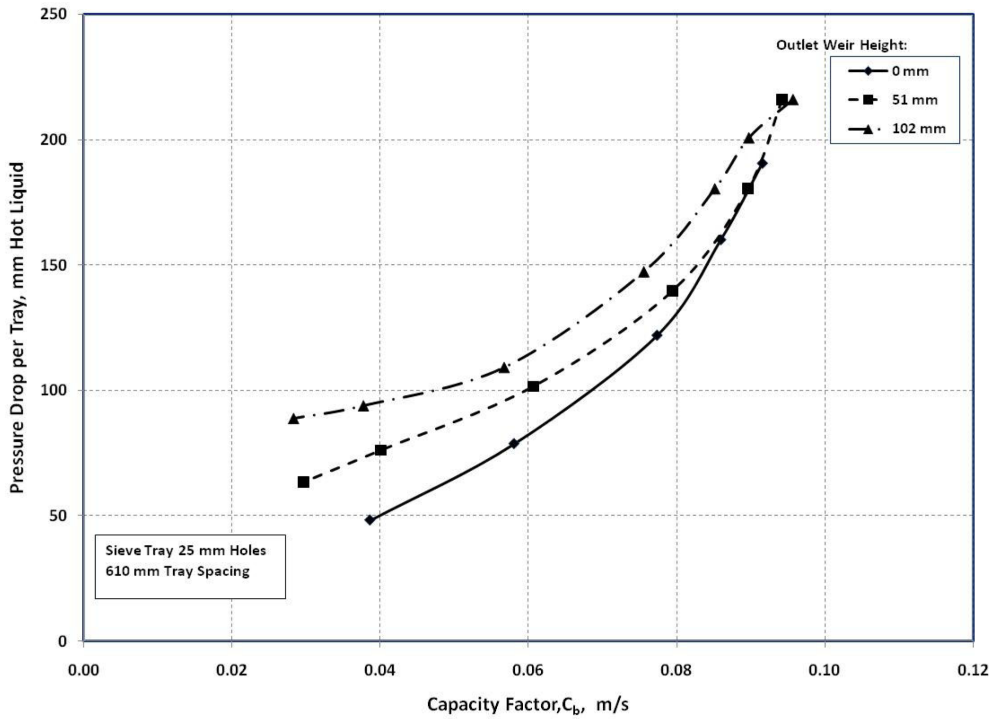

Figure 27. Effect of Weir Height on Pressure Drop for 8% Hole Area Tray (iC_4/nC_4 at 11.38 bar Pressure)