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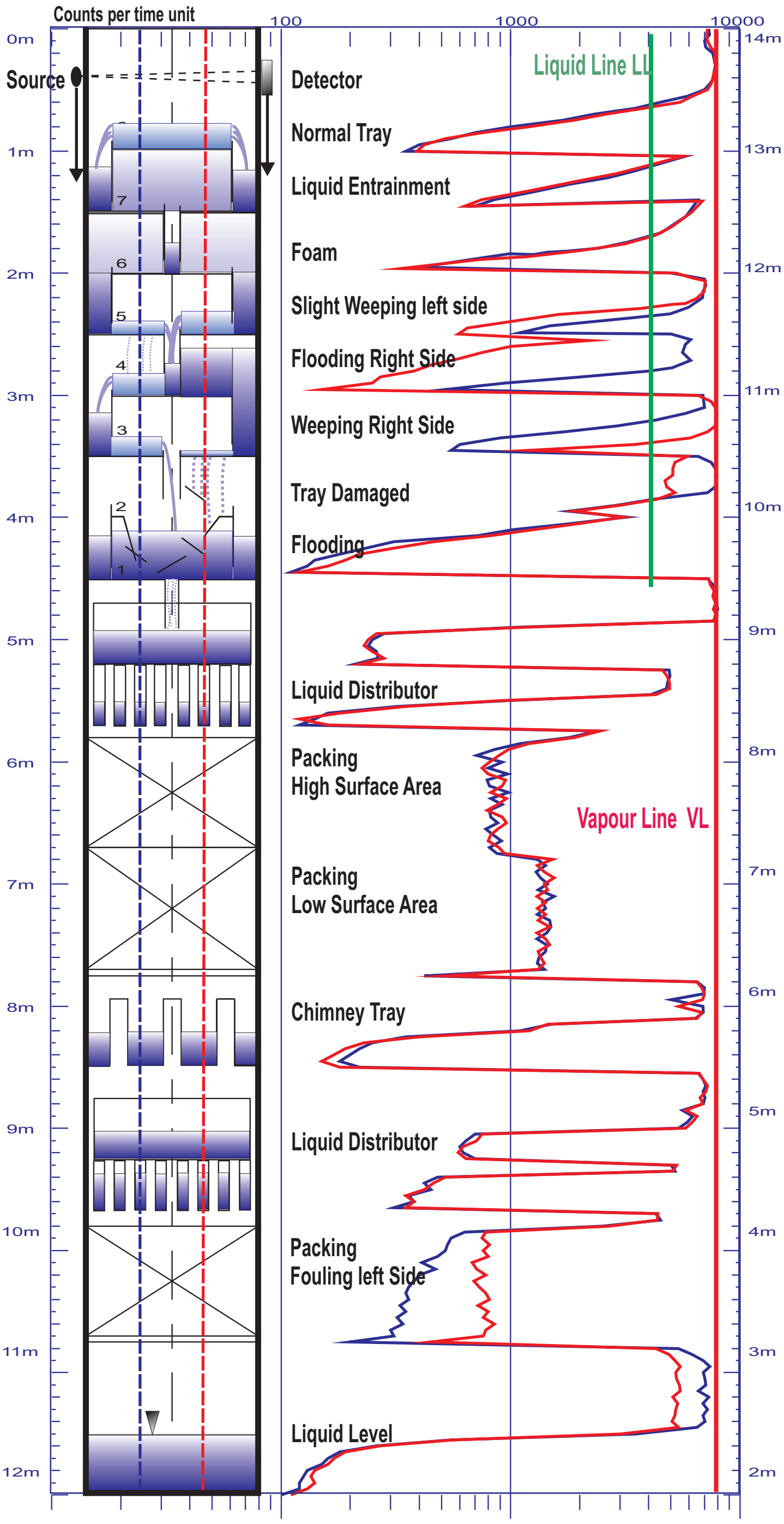
Model Column

Fig. D1



Operating Conditions:

At normal operation of a column the vapour space densities are similar in top, in areas of large tray spaces and between the lowest tray and liquid level in sump. These vapour space densities are quite essentiell for the assessment of the operating conditions of trays.
Normal working trays show also similar vapor space densities above the froth as in the top or below the lowest tray. The vapourspace density increases when liquid becomes entrained. It can be inter-graded between slight, moderate and severe liquid entrainment.
The lowest vapour density level is marked by the Vapour Line VL (red vertical line).
The Liquid Line LL (green vertical line) is calculated on base of experiments from ratio of impact levels just above the tray deck and in the vapour space.
This line helps to measure the froth height on the trays. At the upper cut point of each tray peak the froth height can be measured using the scale of the diagram. If the rate of impacts is lower than the impact level of the Liquid Line we define that the trays start to become flooded.
It is distinguished between Jet Flooding, Downcomer Flooding and Choke Flooding.

Jet Flooding

At high vapour rates or if the cross flow area of the vapour is reduced due to fouling resulting in excess vapour velocities a severe impact hits the froth layer resulting in liquid entrainment.
The tray capacity is limited by type, column diameter, downcomer and tray space.
If the froth height approaches the tray above, causing liquid back mixing and therefore loss of separation efficiency and pressure drop will increase due to liquid accumulation.
This condition is called froth entrainment flooding.
At low liquid flow rates trays operate in the spray regime where most of the liquid is in liquid drops. If vapour velocity is raised, the liquid drops are entrained into the tray above and accumulates there instead to flow to the tray below.This is called spray entrainment flooding.

Downcomer Flooding

The liquid level in the downcomer is a function of vapour side pressure drop, frictional losses, liquid height on the tray, liquid crest above the weir and grade of deaeration of the liquid.
The vapour side pressure drop affects the main part of the liquid level. As pressure drop increases due to fouling on the tray deck or due to increased vapour velocity because of stuck valves the aerated liquid will backup in the downcomer accummulating liquid on the tray deck and successive on the trays above. This condition is called downcomer backup flooding.
Downcomer backup flooding can be expected in case of fouling in the DC where the outflow of liquid is affected.
In many cases there is a combination of downcomer backup and jet flooding.

Choke Flooding

This phenomenon is due when the geometry of the downcomer entrance is too small for the aerated liquid rate. The deaeration in the downcomer and the flow of aerated liquid in the downcomer are hindering each other and therefore choking the downcomer following flooding the tray deck.

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