DESIGN CONSIDERATIONS FOR DISTRIBUTION BAFFLES – HORIZONTAL DRUMS

There are well established industry rules and guidelines (such as API guides, Shell DEP's and NORSOK Standards) for the design of new separators and inlet/outlet devices when it comes to feed inlet and gas/liquid outlet velocity and momentum. They provide a broad consensus on the maximum allowable loadings for different layouts and devices. Although the use of perforated plate type baffles is widely specified to assist with creating plug flow conditions in the liquid phase, the detail of the design is somewhat lacking. Some aspects are suggested however:

- Location of inlet baffles typically 0.25D to 0.45D (ADNOC[1]) (Shell[2]) from inlet tan line to 1st & 2nd inlet baffle (subject to inlet device detailed layout)
- Perforations 12mm diameter and 20% free area if single baffle, or 30% + 50% free areas if dual baffles used (Shell[2])
- Primary & Secondary baffle spacing typically 0.2D (Shell[2])

OTHER RESEARCH

Researchers[3] at Herriot-Watt University have shown that simple, perforated plate baffles across the flow stream near the inlet do increase uniformity of the flow across the separator from a short distance downstream of the baffle. The effects were investigated of varying the hole size and free area of the baffles. The size of the holes was found to have only a small effect on the distribution even though the hole size was varied sufficiently to cover both laminar and turbulent flow regimes through the holes. On the other hand, it was found that 10% free area gave a substantial improvement in uniformity of flow distribution across the cross section compared to baffles having 5%, 15% and 20% free areas.

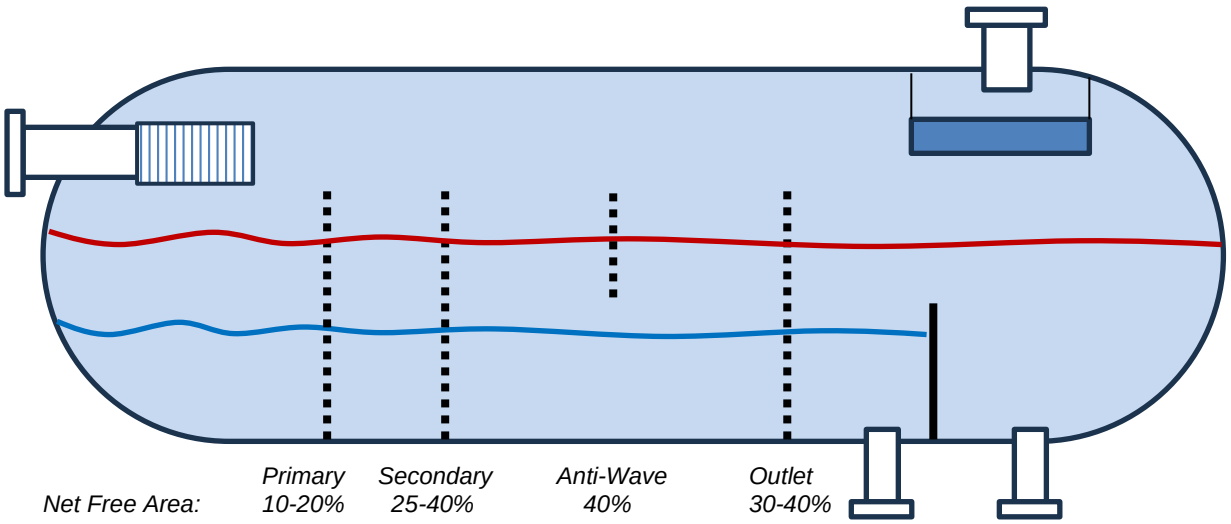

Fig.1: Baffle Applications & Typical Specification

SINGLE OR DUAL INLET BAFFLES

Typical situations where each type should be considered:

Single Baffle	Dual Baffles
• 2 Phase Separators • 3 Phase duty where there is a coalescer pack installed after the Primary baffle • 3 Phase duty where the conditions are relatively benign (low inlet velocity, low liquid axial velocity, ample residence time)	• 3 Phase separators (ADNOC[1]) • For 2 Phase duty but where there is risk of poor flow due to high liquid velocity or low residence time

OTHER BAFFLES

Anti-wave baffles should be considered where the gas velocity (K-factor) exceeds 0.1 m/s (0.3 ft/s) and the free, unbaffled liquid surface length exceeds 6m (20 ft). This will mitigate the risk from wave creation due to gas drag force and hence unstable liquid level measurement.

Outlet zone baffles are sometimes considered, again where the vessel length is significant and there is an elevated risk of channelling occurring due to the vessel wall surface drag, despite upstream inlet baffles. These are located close to the liquid outlets/weir and, as they are generally in the zone with separated liquid, there is low risk from agitation and mixing.

Specialist anti-motion (FPSO) baffles are not considered here as they require custom design.

FULL HEIGHT OR PARTIAL DIAMETER

Most baffles will extend to the liquid HH level, or HH plus a small margin for waves. In some cases, it may be preferred to have a full diameter Primary calming baffle to include gas distribution. For example:

- Slugging flow, where liquid level instability is possible
- Situations where gas path channelling to the outlet demister device is possible, due to the use of e.g. inlet cyclones, an unusual internals layout or other factors

If foaming is possible, then the impact needs to be carefully considered as it could exacerbate the situation and the use of a bespoke defoaming device would be better.

REFERENCES

1. ADNOC AGES-GL-08-002 r1 (2021) *Vessel Sizing (2 Phase/3 Phase) Guidelines*
2. Shell DEP 31 22 05 12 Gen (Feb 2017) Gas/Liquid, *Liquid/Liquid and Gas/Liquid/Liquid Separators – Type Selection & Design Rules*
3. Wilkinson, D., Waldie, B., & Nor, M. I. M. (1998). *Improving oil/water separation in primary separators.* 157. Paper presented at World congress on particle technology 3, Brighton, United Kingdom.