eDART
DISTRIBUTION & SPLITTER BOXES

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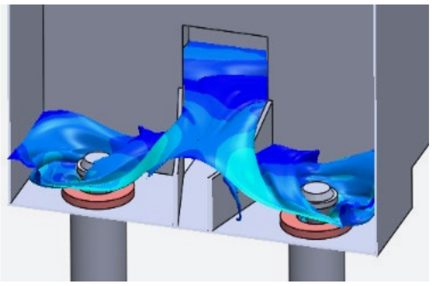
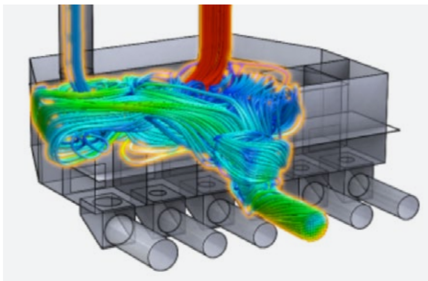
SPLITTER BOX AND DISTRIBUTION BOXES

The splitter box and distribution boxes serve as essential devices for dividing a slurry feed into multiple outlet streams, ensuring the uniform distribution of particle sizes and controlled flow to each outlet. However, their significance is often overlooked by process engineers, piping engineers, and mechanical engineers, who commonly leave their design to the draftsman to fit within the available space.

Recognizing this opportunity, eDART, an engineering company specializing in slurry valves, has added this crucial piece of process equipment to its product offering. With the use of advanced tools like Computational Fluid Dynamics (CFD), eDART has successfully established its expertise in optimising the performance of these devices.





DESIGN

The design of the splitter box follows an iterative process, commencing with calculated dimensions that are subsequently analysed using Computational Fluid Dynamics (CFD) software. Based on the analysis results, adjustments are made as necessary. CFD is once again employed to evaluate the refined design. The ultimate objective is to develop an optimally sized distribution box that aligns with the specific process requirements.

CFD modelling plays a crucial role in assessing the behaviour of the slurry as it flows through the distribution box, aiding in the achievement of an effective design solution.

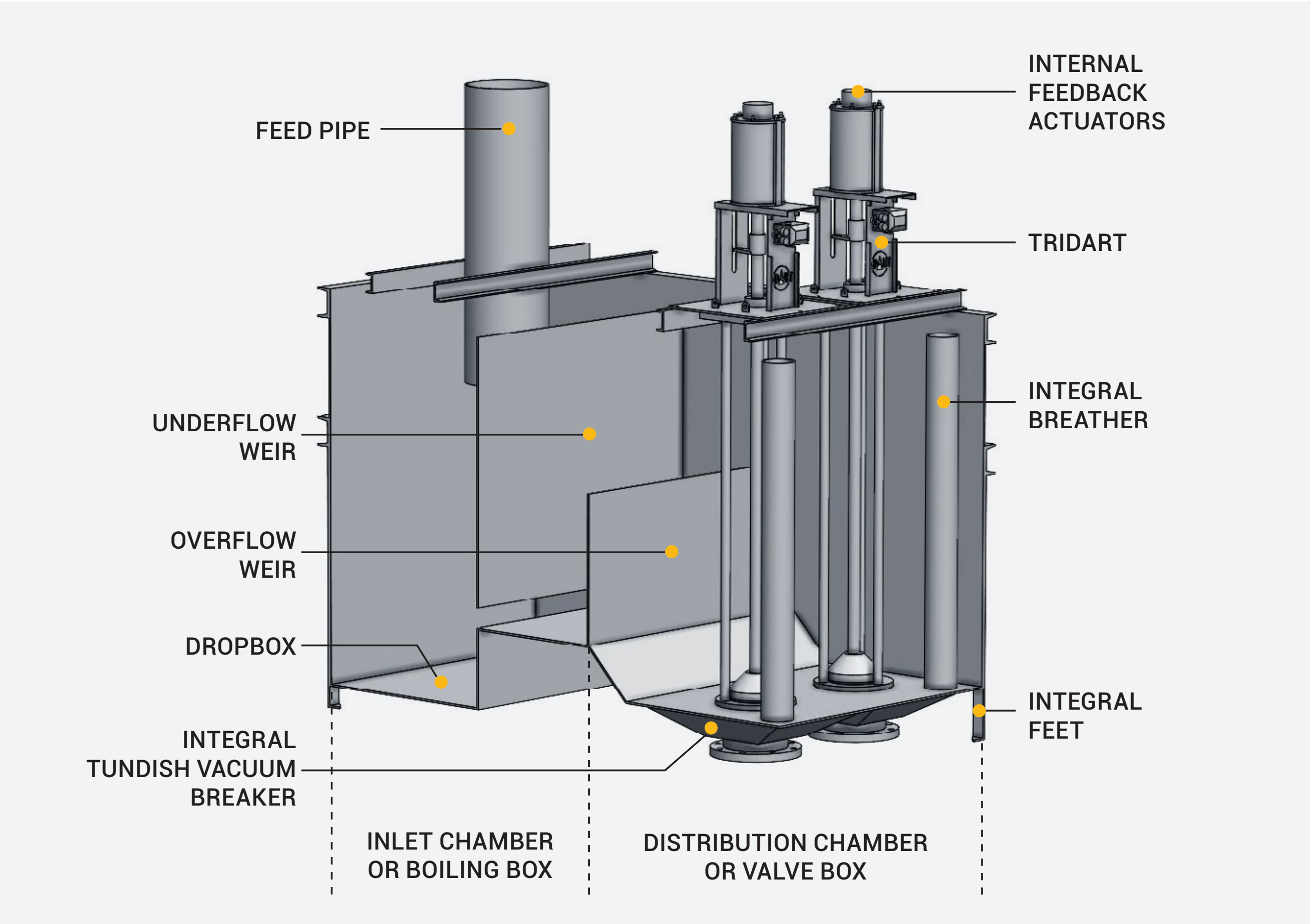
1. **Inputs required before one proceeds with design:**
   a. **Process data required:**
      i. Minimum, normal and maximum flow
      ii. % solids
      iii. Slurry SG
      iv. PSD (particle size distribution)
   b. **Plant layout, or current box design**
   c. **Include discharge piping**

2. **Functional description. The box functionality in all modes of plant operation needs to be established, for example, if one outlet is offline then is the feed to be equally split to the others**

3. **Air Fail action for the valves**

NOMENCLATURE

Distribution box and splitter box are two names for the same piece of process equipment, it is generally site-specific. However, the engineering of the box requires internal features that are named as shown below.



Splitter box nomenclature

The Standard eDART Splitter Box concept has the flowing components:

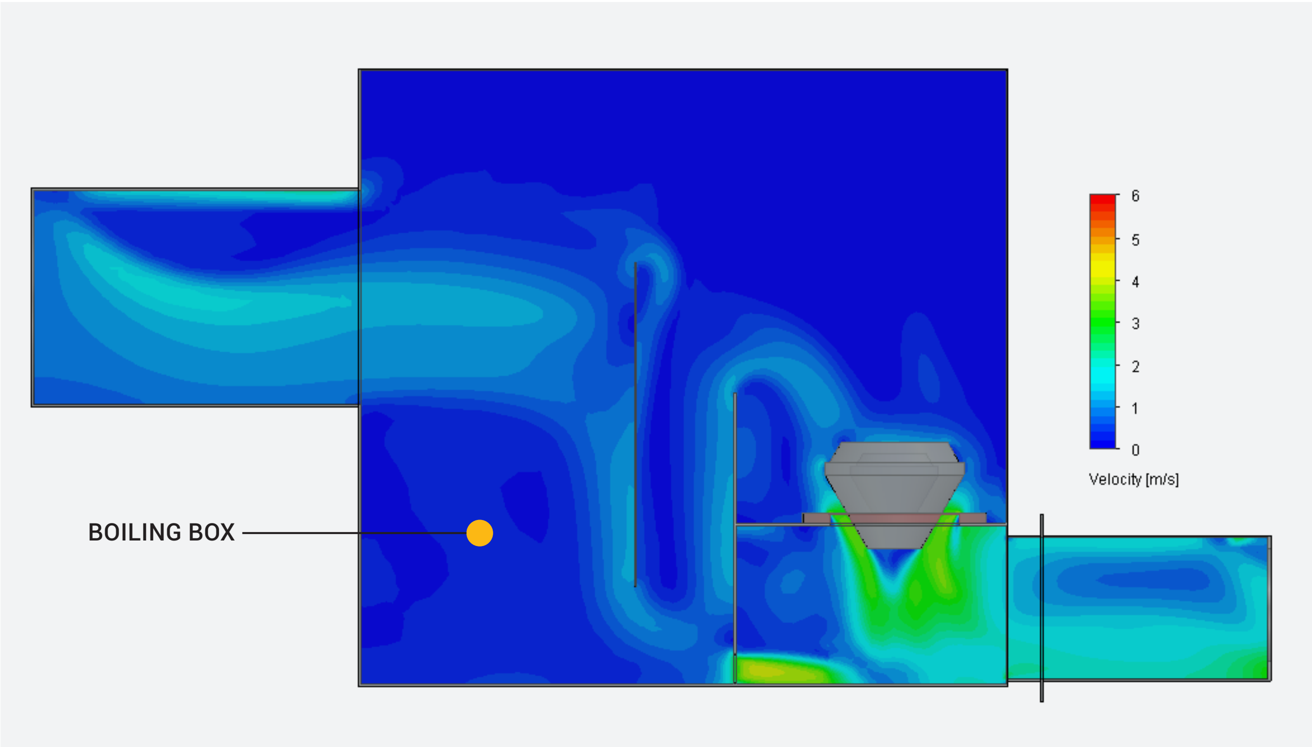
- **Inlet chamber** - also called the "Boiling box". The feed is fed into the boiling box
- **Under/over weir arrangement** - used to smooth out fluctuations in feed to the distribution chamber
- **Distribution chamber** - this chamber houses the outlet valves and serves to keep a constant head on the outlet valves thereby making flow control possible
- **Overflow facility** (Recommended). The rule of thumb is that the overflow pipe should be sized one size larger than the feed pipe

FEED PIPE SIZING

Perform a straightforward velocity calculation to provide a measure of the fluid velocity in the inlet pipe. It is important not to have too great of a jet into the boiling box. Pre-conditioning of the inlet stream is sometimes required. The flow simulations are important here.

BOILING BOX

It is important to examine the potential wear patterns on the floor of the boiling box. If the velocity on the floor is high, it is advisable to contemplate increasing the depth of the box. Additionally (or alternatively), to enhance wear resistance and provide heightened protection in this area, it is recommended to incorporate a removable floor featuring an extra-thick polyurethane coating.



In this example, a cross-section showing a velocity plot shows the boiling box being fed from a side entry inlet pipe. The trajectories flowing under the first weir and over the second are clearly illustrated

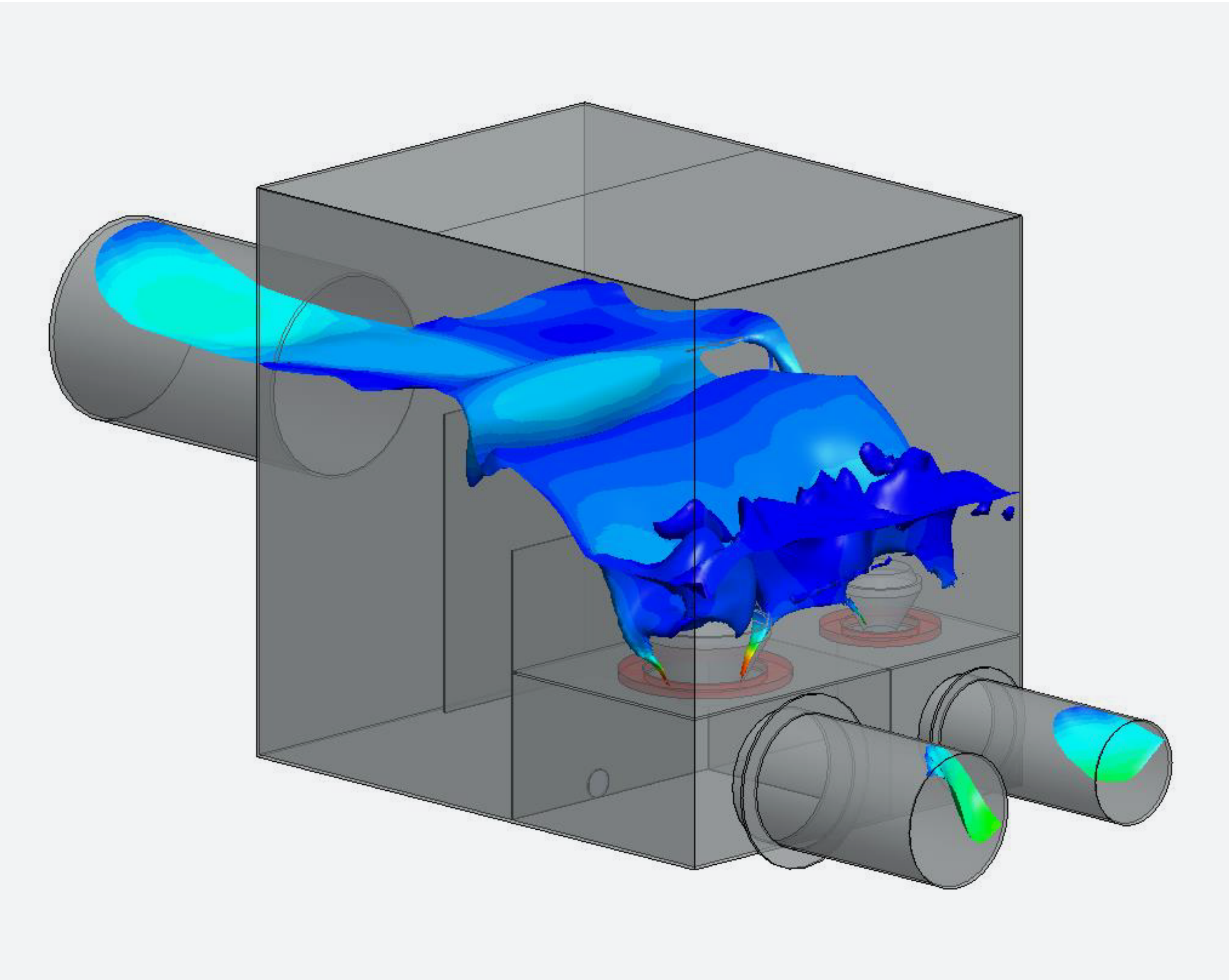
By employing CFD, the top level of the slurry can be determined, allowing for a thorough evaluation of the splitter box's volume. This assessment aids in identifying the optimal operating level of the slurry within the splitter box. It is essential to maintain a sufficient freeboard above this level to effectively contain splashing and accommodate any potential surges.

A highly turbulent surface level, as indicated by CFD analysis, suggests the presence of splashing. In such cases, it is advisable to reevaluate the feed pipe size, geometry, and entry into the boiling box to mitigate and eliminate splashing. It is worth noting that submerging the pipe below the surface can potentially alleviate splashing, although this adjustment may have an impact on flow rates and the performance of upstream equipment.

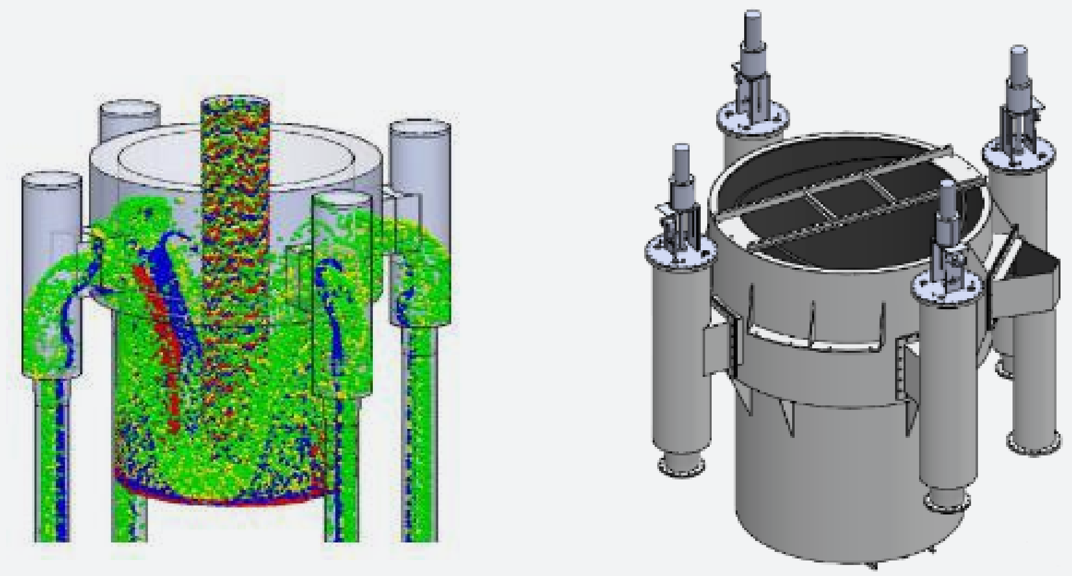
GEOMETRY OF THE SPLITTER BOX

To ensure a consistent Particle Size Distribution (PSD) of the outlet slurry, it is important to position the outlet valves at equal distances from the weir. This balanced configuration allows for similar hydraulic conditions across each outlet, often promoting uniformity in particle distribution and size. By maintaining equal distances, the hydraulic forces acting on the slurry within the splitter box remain even, reducing variations in the PSD.

This precise valve placement enhances the efficiency and effectiveness of the mineral processing operation, resulting in improved product quality and process performance.



The eDART analysis includes simulating the free surface. If this was the normal operating condition, the chaotic nature of the surface in the distribution chamber is one indication that the box should be larger



Interestingly, there were initially two feeds into this box, and the velocity plots suggested even feed to each outlet, however, when the particle sizes reporting to each outlet were studied, it was apparent that a more symmetrical design was required

DISTRIBUTION CHAMBER CONSIDERATIONS

Ensuring that the splitter box has sufficient capacity to accommodate all the outlet valves effectively is crucial. For optimal splitting and distribution, it is important to maintain a consistent slurry level above all valves. This practice improves the regulation of output flow rates.

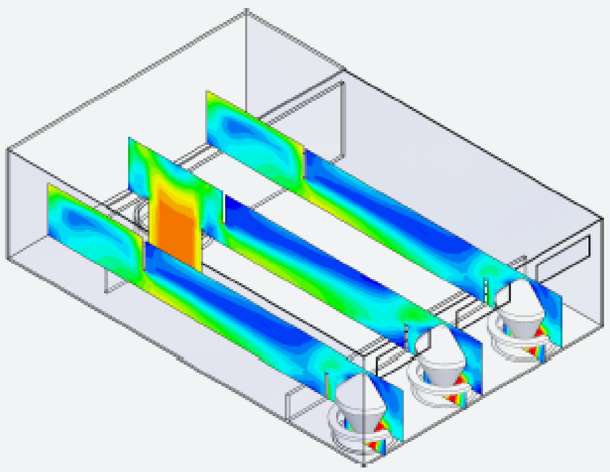
To ensure proper valve sizing, it is recommended to consider the slurry height above the valve seat as the reference step height. The design of the splitter box should allow the slurry level to rise to a minimum of twice the step height, enabling it to handle surges or high feed flow rates effectively. Implementing this concept of variable step height facilitates sizing the valves to be 50% open (on the stroke) during normal flow rates while utilizing the maximum step height for handling maximum flow rates. It is important to note that a 50% stroke often corresponds to approximately 70% of the valve's volumetric flow capacity. Collaboration with a valve supplier is crucial in this sizing process, and it highlights the key reason behind the success of eDART's expansion into the field of splitter boxes.

To assess the performance of the splitter box, use CFD analysis to examine both high and low-velocity conditions. Low velocity indicates the potential for settling, while high velocity may accelerate wear within the box. This analysis helps identify areas where adjustments or improvements may be required to optimise the performance and longevity of the equipment.

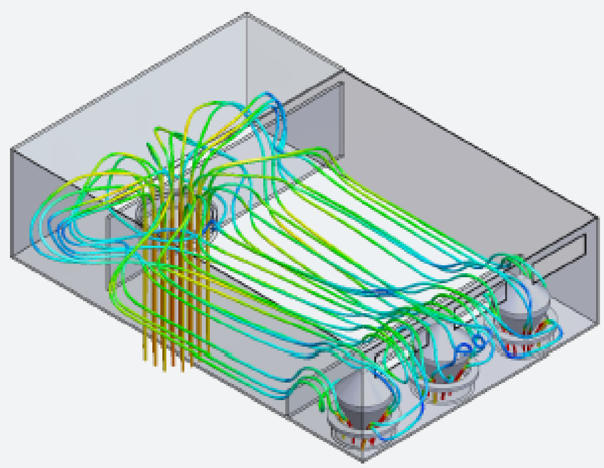
OUTLET VALVE SIZING

For sizing valves, it is recommended to use the ideal step height of 50% open to accommodate normal outlet flows. It is important to check each valve individually, as variations in outlet flow among the valves are common. To handle maximum flow rates, valves should be sized based on the maximum step heights. The advantage of employing a variable step height approach is that it often allows for the use of smaller valves compared to those specified for valves with fixed step heights, such as in flotation cells.

This flexibility in sizing valves enables more efficient and cost-effective design solutions within the context of splitter boxes.



VELOCITY CONTOURS



VELOCITY FLOW LINES

OUTLET FLOW

eDART typically integrates an Integral Vacuum break into the distribution box to achieve optimal outlet flow. This design feature ensures efficient operation and enhances the overall performance of the system, particularly in scenarios where the discharge drop is significant or when precise flow control is of utmost importance.

GENERAL CONSIDERATIONS:

- Consider the mass of the distribution/splitter box when full with solids at given solids SG for structural weight requirements
- Consider access to the valves for maintenance. This may affect where you locate the structural supports for the box
- Consider structural reinforcing and supports for the box
- Consider the overflow requirements, and the effect of valve failure or downstream interruptions
- Consider a drain valve
- Consider lifting lugs for rigging the box into place
- Consider all flanges on the box, locate these so they will not be damaged during transport

TALK TO US ABOUT SOLVING
YOUR SLURRY RELATED CHALLENGES

eDART designs and manufactures slurry equipment to improve recovery rates for metallurgical plants. We combine our Computational Fluid Dynamics (CFD) expertise with extensive site experience to reliably solve your complex slurry challenges.

How can we help you?

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