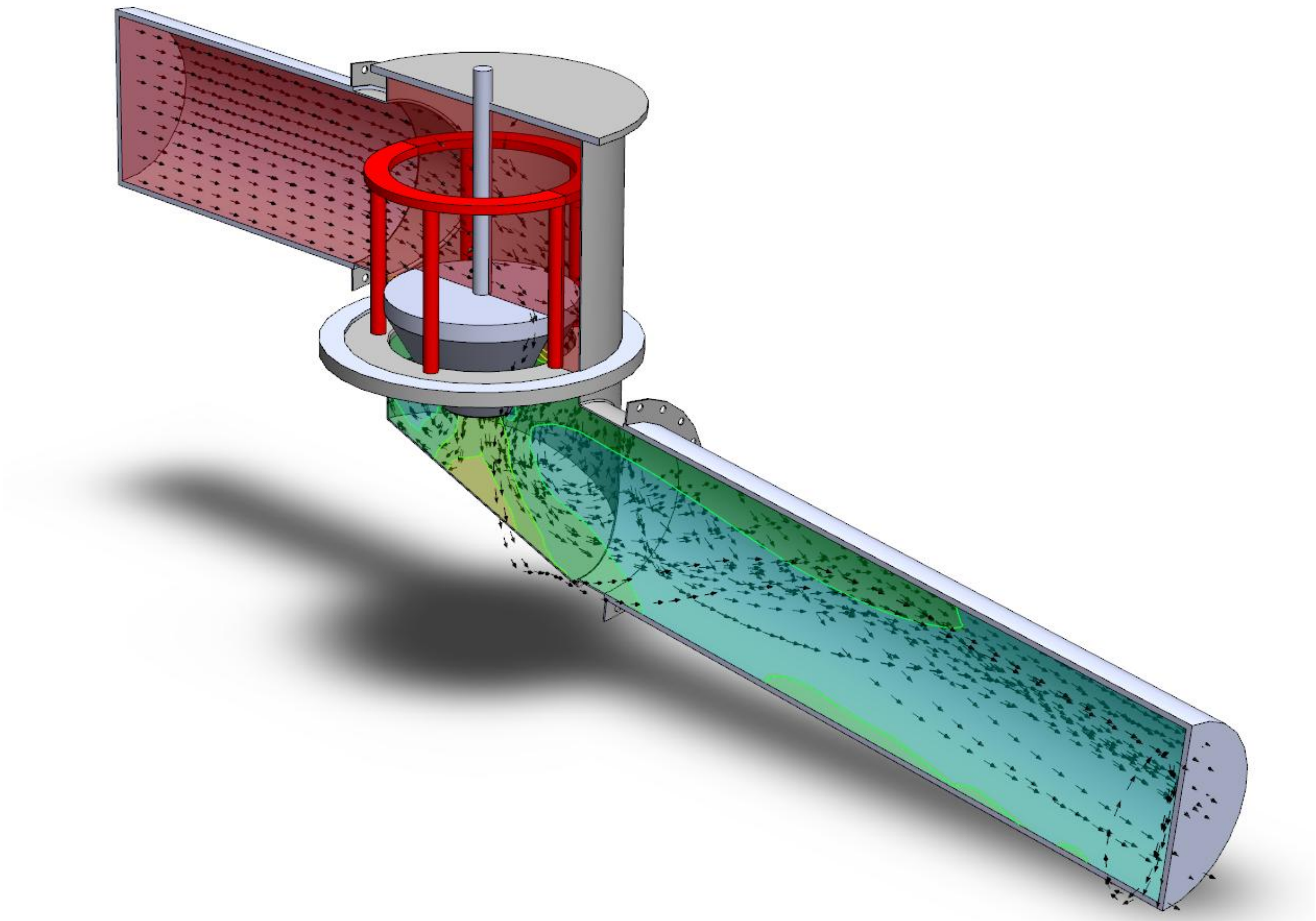


1. Introduction

eDart has two approaches to solving industry related problems. The first is to use engineering principles and excel like calculations to understand the problem. The second is to analyse the problem using computational fluid dynamics software. Here there are two approaches which depend on the exact system to be studied. The first method is to consider the problem in three-dimensions, model it in SolidWorks CAD and apply the fluid boundary and initial conditions with ***FloEFD***. The second method is used when the problem extends beyond a simple 3D representation of the problem to the system dynamics. Here the one dimensional system-level CFD ***Flownex*** is used. The following two chapters will clarify these approaches by using examples.

2. 3D Computational Fluid Dynamics

eDart uses a 3D Computational Fluid Dynamics Software package called FloEFD which is integrated into SolidWorks CAD. It is produced by Mentor Graphics (formally Flomerics-NIKA) and supported by ESTEQ Engineering (Pretoria, previously MSC-Africa).

We have consulted on industrial flow problems using FloEFD as a tool for companies including Tellumat; the South African Astronomical Observatory; PPC de Hoek; Trucking Engineering Services; South African Nylon Spinners; Optimal Energy, Mitech/Spirax-Sarco; Peralex, Avitronics and our own eDart Products.

The diversity of problems analysed can be shown in a few case studies.

2.1. Mixing in a Heat Exchanger

In this problem, a valve controlled the flow through a large diameter bypass line down the centre of the shell and tube heat exchanger for a South African Petrochemical Company. This allowed hot gases through the exchanger to mix with the cooler gas that had travelled through the heat exchanger pipes. The shape of the diffuser after the iris valve is critical to ensure a good mixing profile and an analysis was done to optimise the diffuser design.

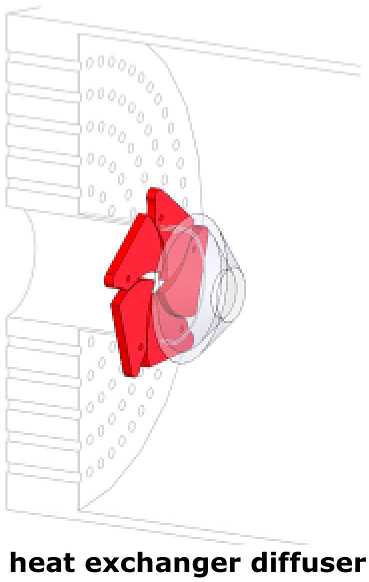
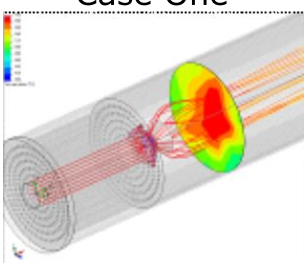
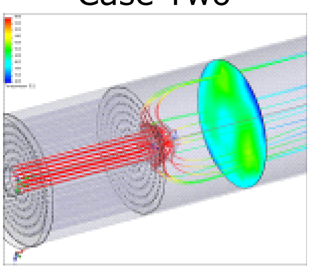


Figure 1: heat exchanger diffuser design

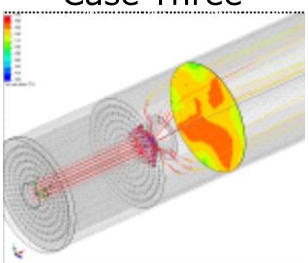
Case One



Case Two



Case Three



Case Four

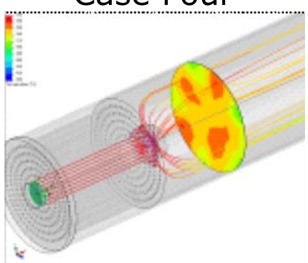


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Figure 2: Back to Back Studies of a heat exchanger to improve mixing of the bypass gas

2.2. Severe Service Pressure Drop Trims for valves

Severe-service high-pressure drop energy-dissipating mechanisms have been examined extensively. Here we use expansion and contractions; swirling; impact, impingement, change in direction and large surface areas to reduce the pressure in both gases and liquids

It is crucial to identify localised regions of low pressure where cavitation will occur in liquids and high mach numbers in gases in these designs.

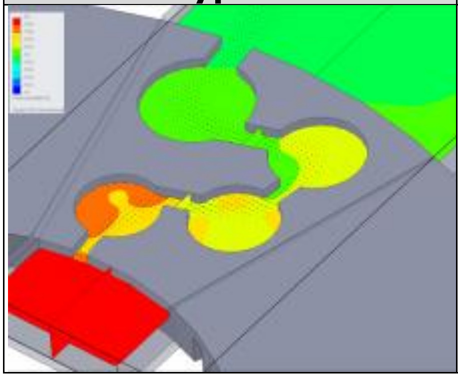
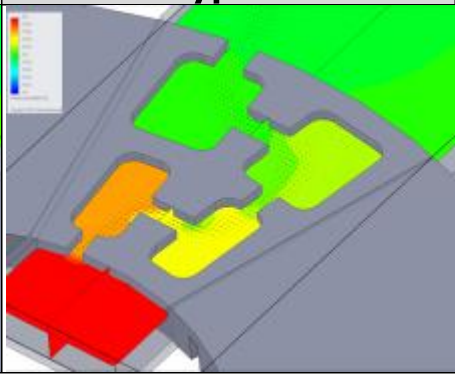
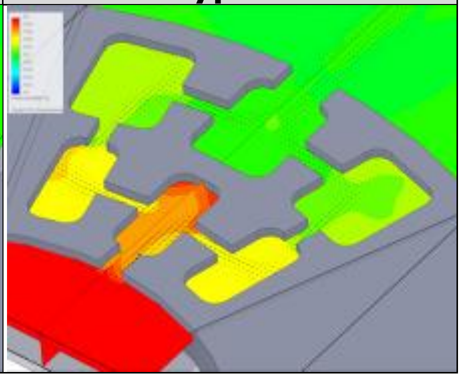
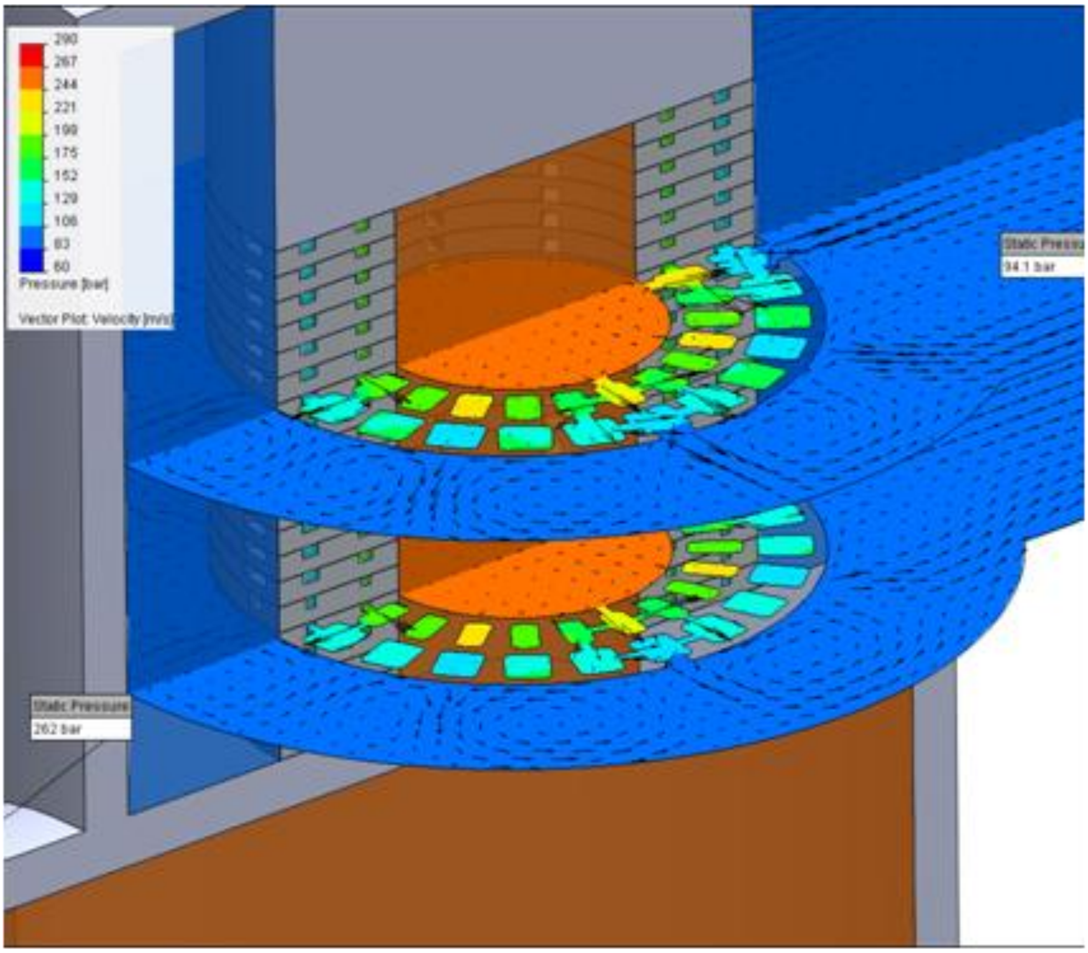
Type 1	Type 2	Type 3
		

Figure 3: Different Passageway types to drop pressure effectively



2.3. Cyclones

The low velocity region behind the vortex finder was examined in this cyclone to study the build up of coke and find a solution for this oil refinery.

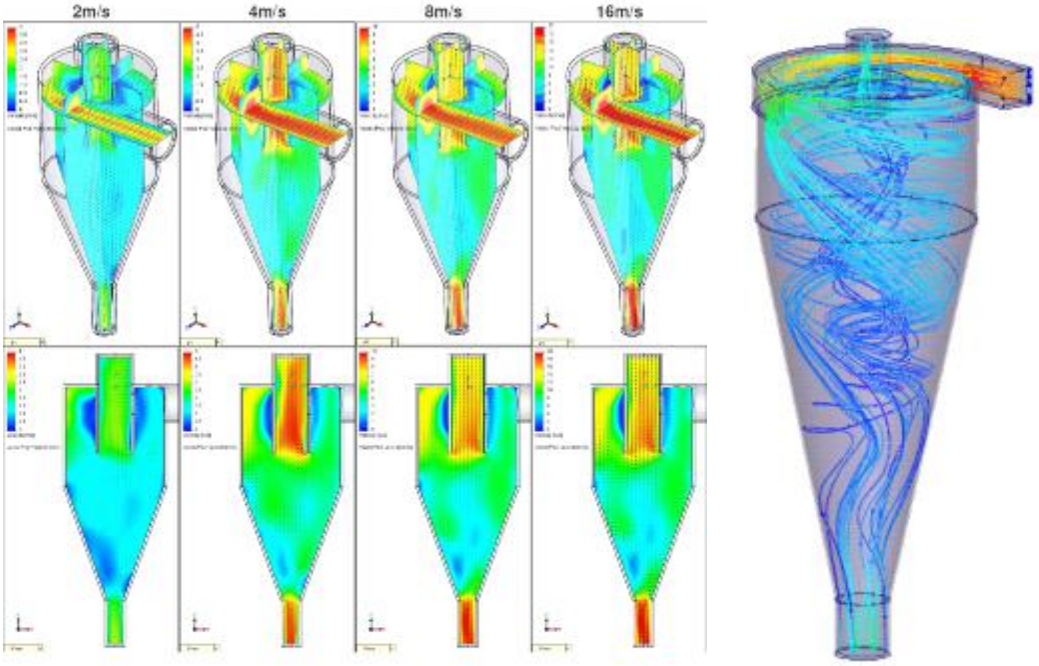


Figure 4: Cyclone Analysis for various inlet velocities

A Supplier of Oil and Gas equipment to the middle east required the separation of different size sand particles out of their wellhead. eDart showed where each sand particle would report.

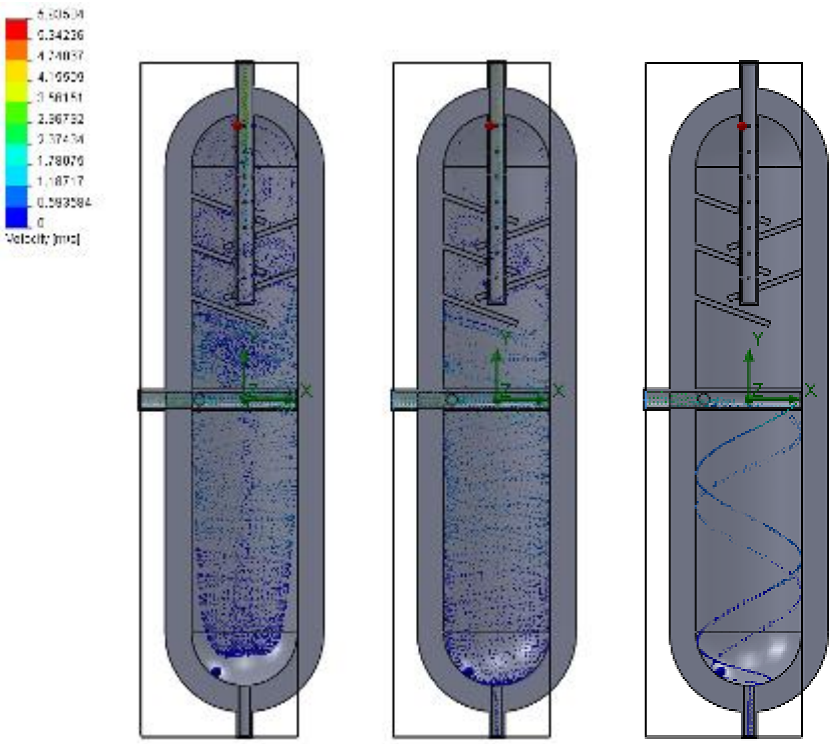


Figure 5: Cyclone Analysis for various particle masses

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2.4. HVAC analysis

eDart analysed the heat distribution in a machine room to better control the HVAC (Heating, Ventilation and Air Conditioning) system for a South African textile company.

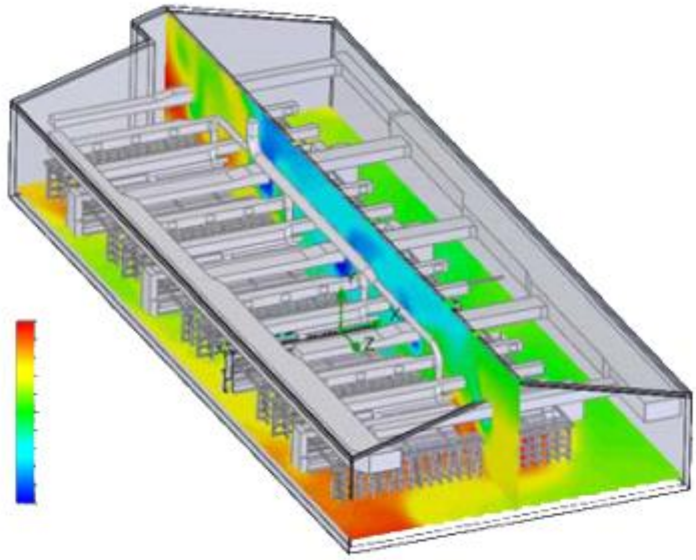

Figure 6: HVAC analysis in a machine room

2.5. Environmental Control

Another example is the flow analysis through the conditioning tower at a South African cement factory. The current system was analysed and improvements to the flow were made without removing the top inlet to change it to the standard "sweep" design. This saved considerable money.

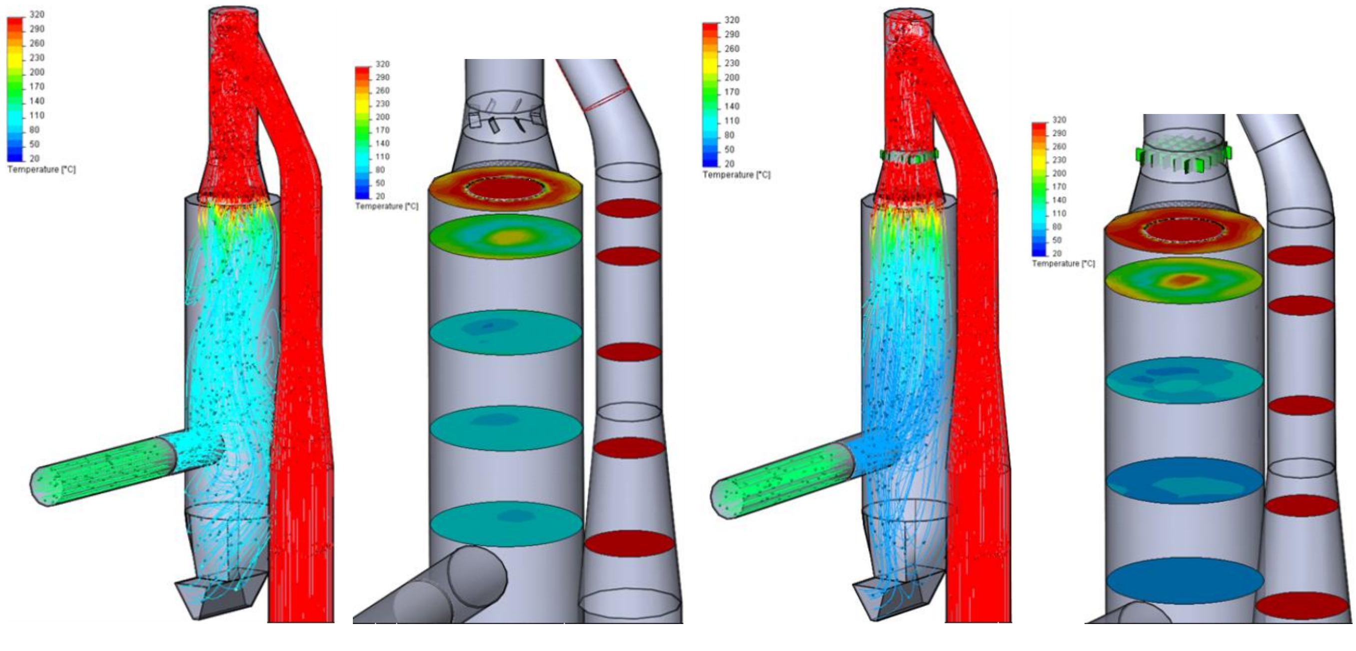

Figure 7: Conditioning Tower Analysis with flow straightener suggestion

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2.6. Slurry Back Pressure Pipes

Backpressure pipes are used on the last tank in a mineral processing bank to reduce the pressure drop across the last valve. eDart examined various configurations to reduce the flow necessary in the underflow.

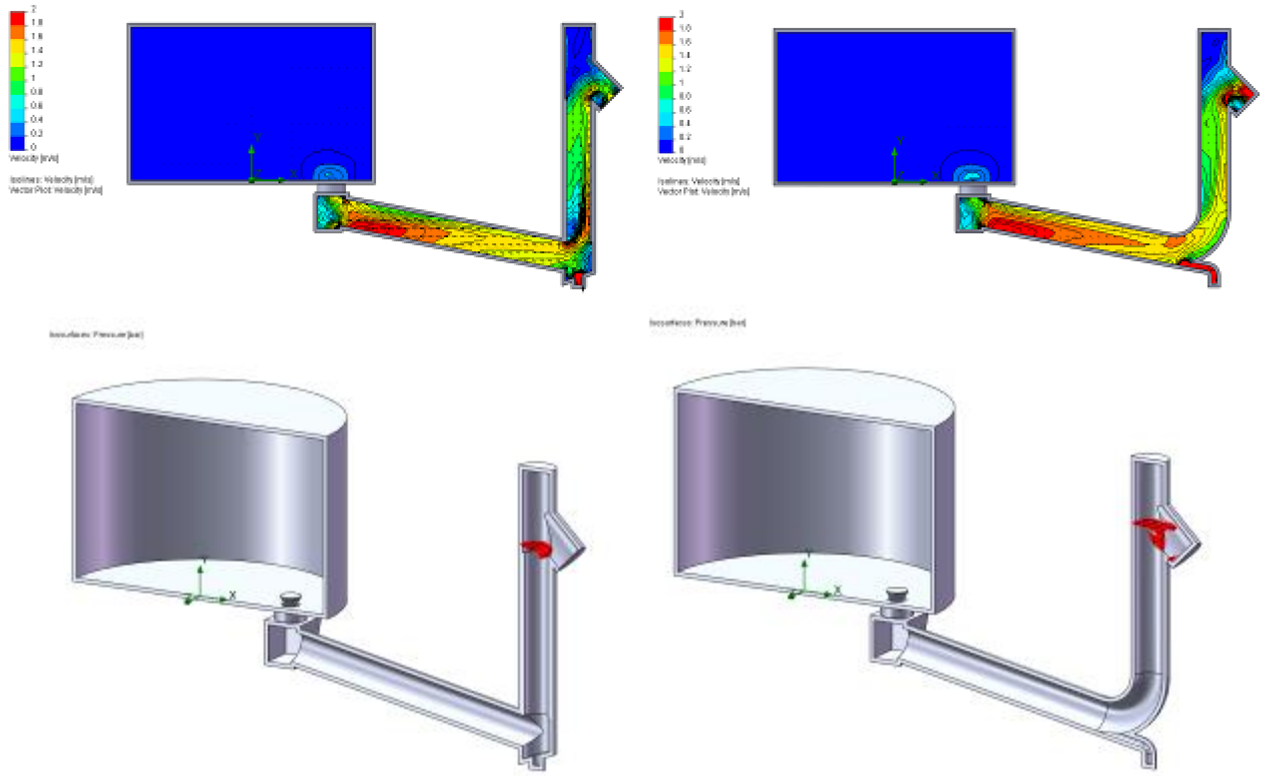

Figure 8: Backpressure pipe configurations

2.7. Retrofits

eDart has made recommendations on how to retrofit valves into existing tanks with minimal disruption and cost by analysing and comparing the options.

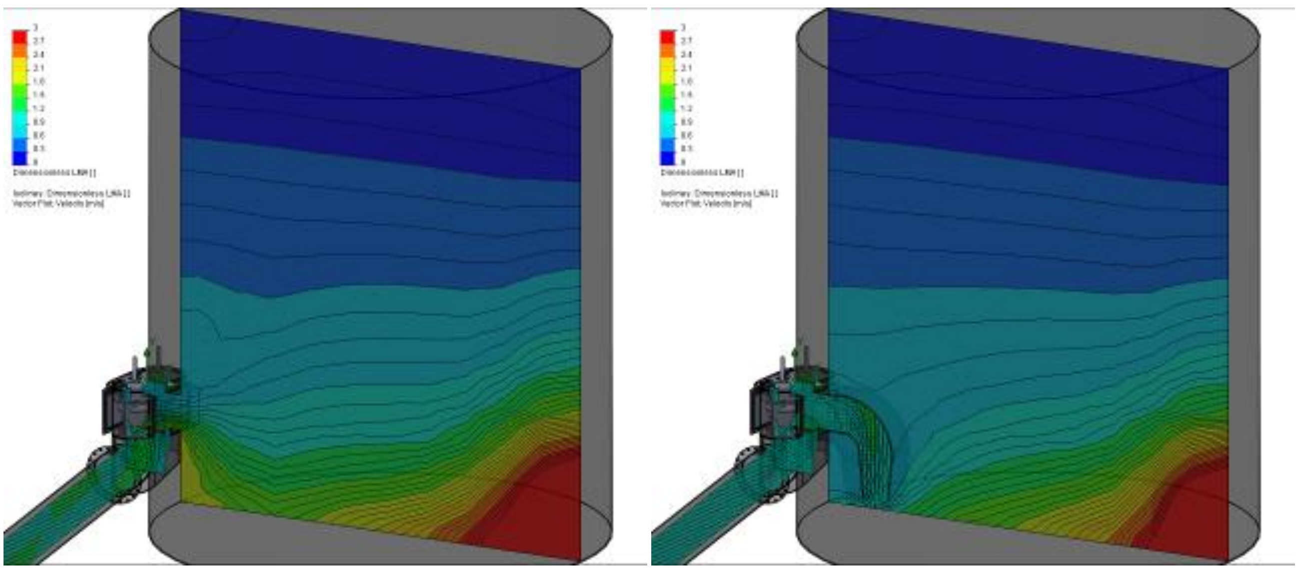

Figure 9: Inlet pipe configurations to a valve

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3. Flownex

The second method of solving an industrial problem when it extends to a system level is to use Flownex which is a 1D Systems CFD program produced by M-Tech and supported by the software distributors: ESTEQ Engineering (Pretoria, previously MSC-Africa). This program is a useful extension of the 3D FloEFD described in the previous chapter.

3.1. Dust Extraction System

eDart has used Flownex to balance the dust extraction system in the automated diamond recovery plant at a diamond mine in Botswana.

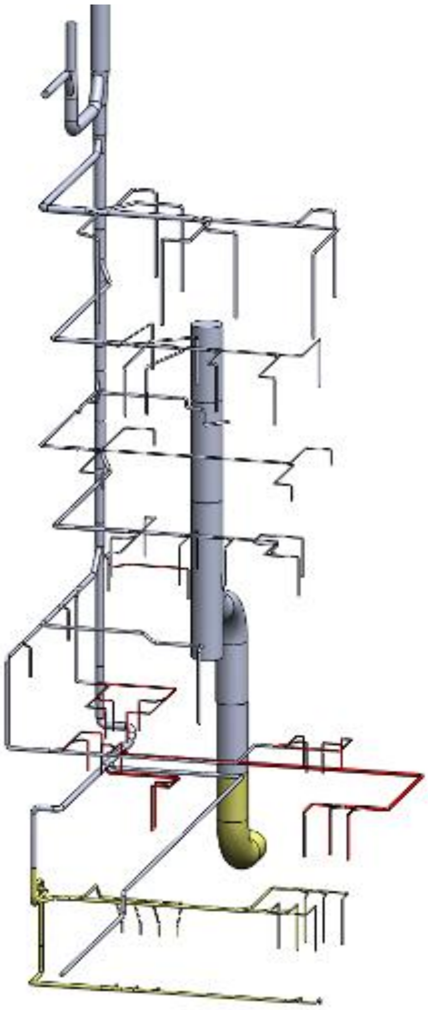

Figure 10: Partial View of Dust Extraction System

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3.2. Oxygen Injection to a blast line

An analysis was undertaken to solve the problem of injecting oxygen into the blastline on a nickel smelter in Botswana. It examined the problem from a system level from the O2 plant through to the furnace and converters.

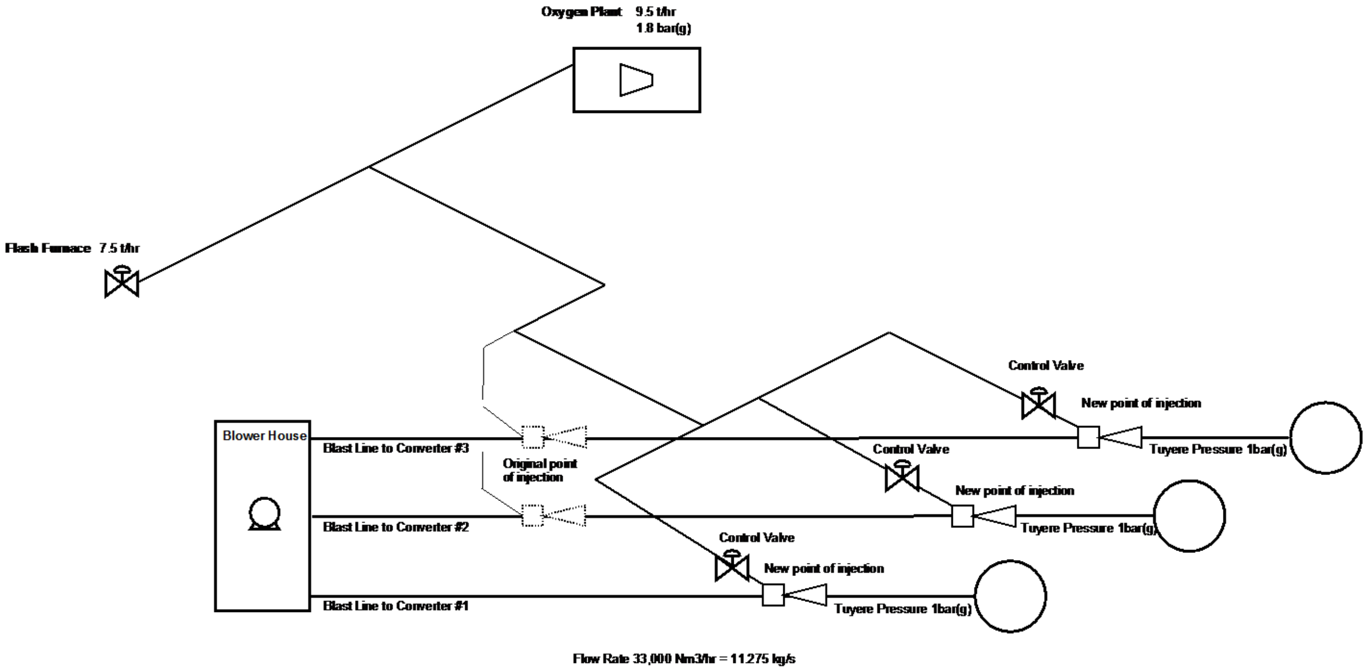

Figure 11: New oxygen lines schematic

Results from the 3D FloEFD were obtained to feed back into the system level analysis. Here injection characteristics of various sparging means were obtained for use.

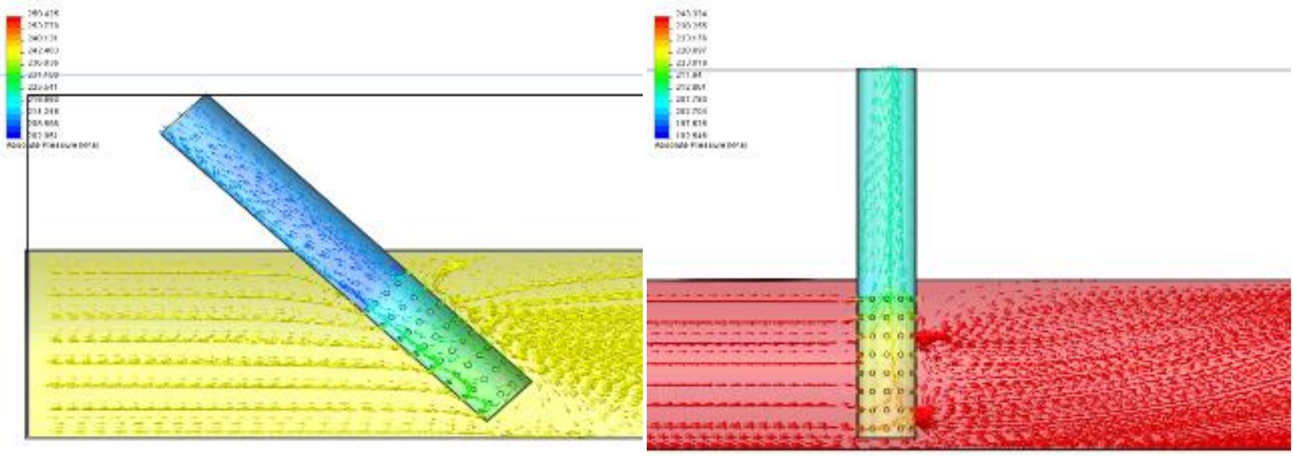

Figure 12: New oxygen lines schematic

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