Research & Development Know-How

CFD (Computational Fluid Dynamics) Analysis

شرکت کانی فرآور کاسپین

Caspian Mineral Processing Eng. Co

Who we are?

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MIN-TEC in Brief

Caspian Mineral Processing Engineering Company (under trade name MIN-TEC) established in 2009 by a group of qualified engineers with many years work experiences in copper & iron mine industries of Iran. MIN-TEC objective plans providing engineering, manufacturing and procurement services as an engineering, consultant or Integrated Project Management Solutions.

MIN-TEC stockholders have sufficient experiences in several the mining projects of Iranian huge mineral processing plants.

Within the years of the hi-level projects experiences, our management team learned how to serve to the clients and meet their requirements.

[Process Engineering] [Equipment design] [Equipment Supply] [Our Workshops]

Management Team

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Abbas Alibakhshi

Director Manager , CEO

- Mechanical Engineer
- Designer of Copper and Iron Plant
- Lime Plants
- Steel Plants
- More than 28 years Experiences

Ms. Nazanin Tayebi

Project Manager , Board Member

- Co-founder
- Industrial Engineer
- Project Control Expert
- More than 15 years Experiences

Saeed Moghani

Factory Manager-ARVAND Factory

- Mechanical Engineer
- Production Expert
- Factory& Site Manager
- More than 17 years Experiences

Dr. Mahdi Alibakhshi

Project Manager, Board Member

- Co-founder
- Ph.D. Civil Engineer
- Concrete & Structural Expert
- 23 years Experiences

Mohsen Faramini

Factory Manager- Alborz Factory

- Mechanical Engineer
- Production Expert
- Factory& Site Manager
- More than 35 years Experiences

What is CFD?

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Computational Fluid Dynamics Analysis

Computational fluid dynamics (CFD) is a branch of fluid mechanics that uses numerical analysis and data structures to analyze and solve problems that involve fluid flows. Computers are used to perform the calculations required to simulate the free-stream flow of the fluid, and the interaction of the fluid (liquids and gases) with surfaces defined by boundary conditions.

به طور خلاصه، دینامیک سیالات محاسباتی ((CFDیک شاخه از مکانیک سیالات است که از تحلیل عددی و ساختارهای داده برای تجزیه و تحلیل و حل مشکلاتی که شامل جریان‌های سیال می‌شوند، استفاده می کند. در CFD، از کامپیوترها برای انجام محاسبات مورد نیاز برای شبیه‌سازی جریان آزاد سیال و تعامل سیال (مایعات و گازها) با سطوح تعریف شده توسط شرایط مرزی استفاده میشود.

Why We Are Using CFD?

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Min-Tec is Using CFD To Develop & to design the Equipment as Below:

1. Heating Systems for Steel Plants , Design the Burners & The Refractory
2. Axial Flow Mixer Tank for Bacteria Preparation and Bio-Leaching Reactors
3. Thickeners Feed-Well Design for Hi-Rate Thickeners
4. Hi-Efficiency Three Phases (Air Injected) Impeller Design for Gold Leaching Reactors
5. Hi-Pressure Tailing Distributers for Tailing Dam

Heating Systems CFD Modeling

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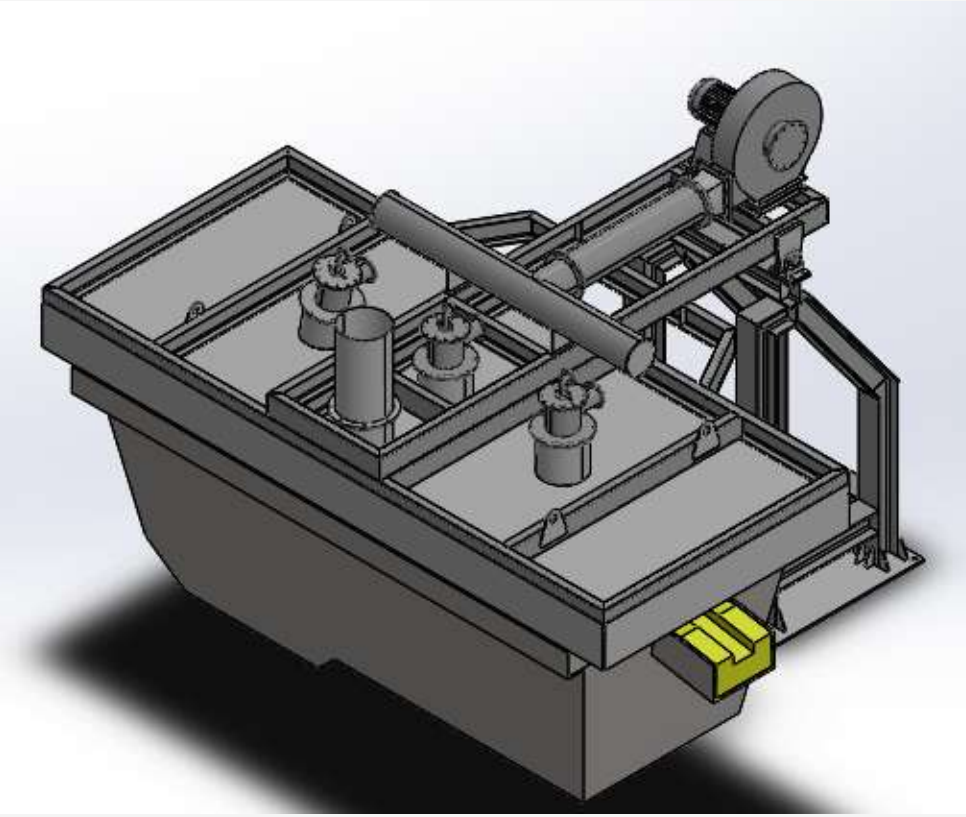
Before the engineering Developments have been started, the system concept has been divided into several items but some of them were similar in all under development systems.

The Eng. Department tried to make a logical way to develop this project in a way that make easier the future Heating Systems using modular modules and components trying to select more easy by the clients.

1 BURNER >CFD Analysis

2 Refractory Re-Engineering

3 Control System



TUNDISH Analytical Model

Heating Systems CFD Modeling

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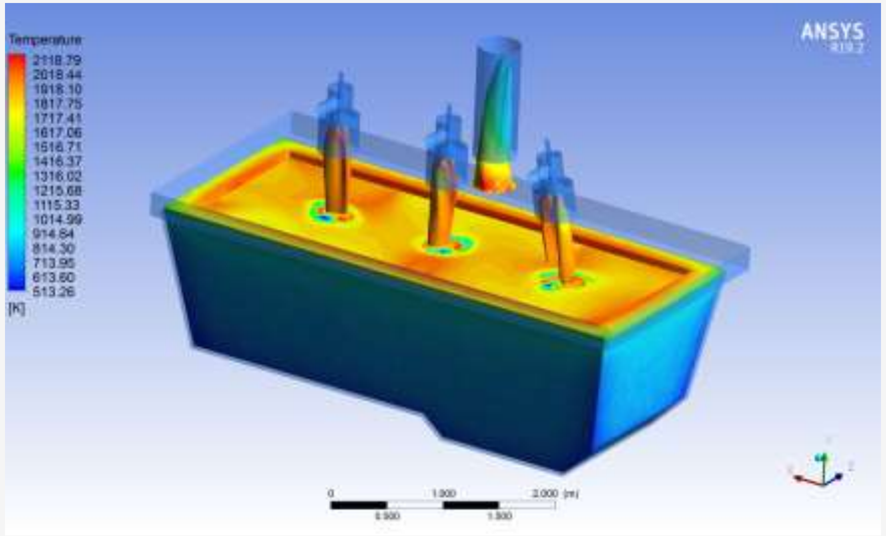
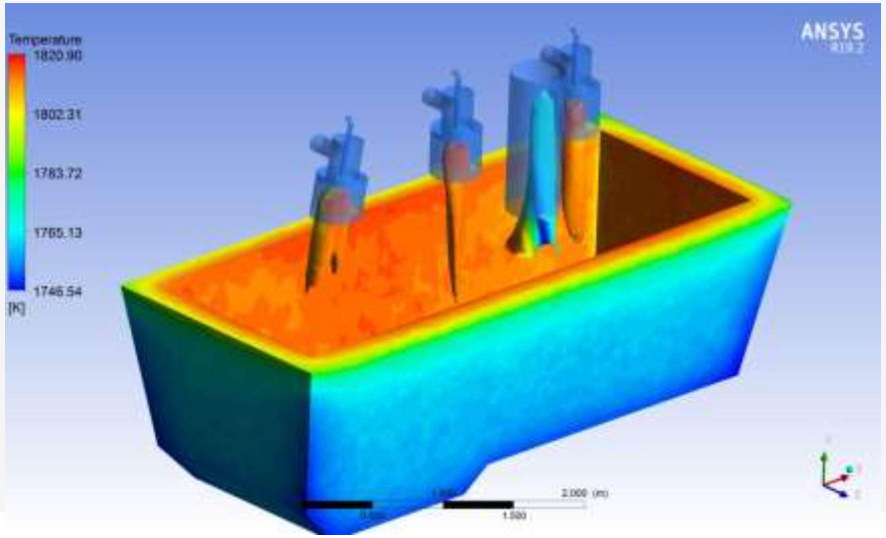
BURNER Computational Fluid Dynamics Analysis

1. Thermal conductivity calculation (Ladle & Tundish) to determine and Solve essential equation.

2. **The Results:**

- Temperature Distribution
- Velocity Distribution
- Tundish and Ladle inner Hot Spot & Cold Spot
- Chimney Temperature Distribution
- Orifice Sizing modifications
- Flame Lengths modified according to type of ladle or Tundish
- Fuel Consumption decreased compare to European References
- Refractory Specifications determination based on the existing material





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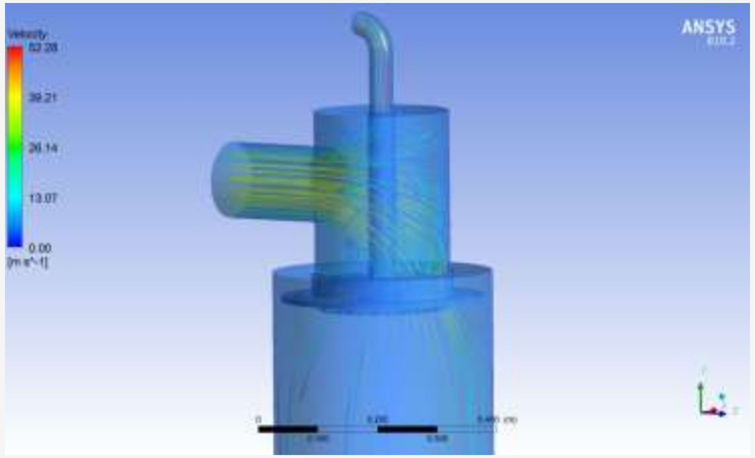
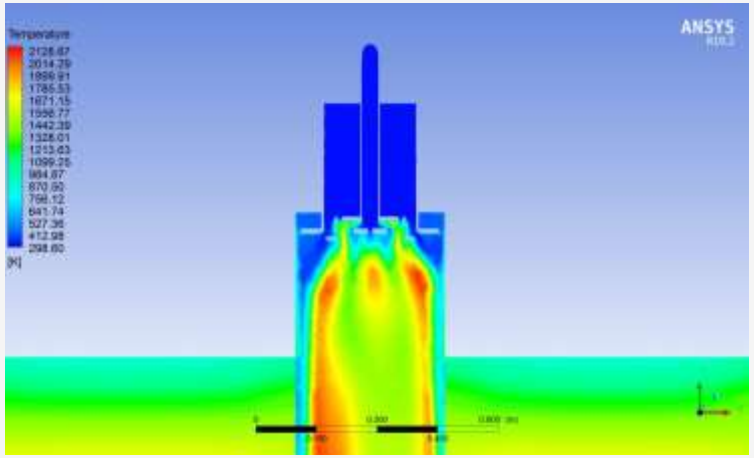
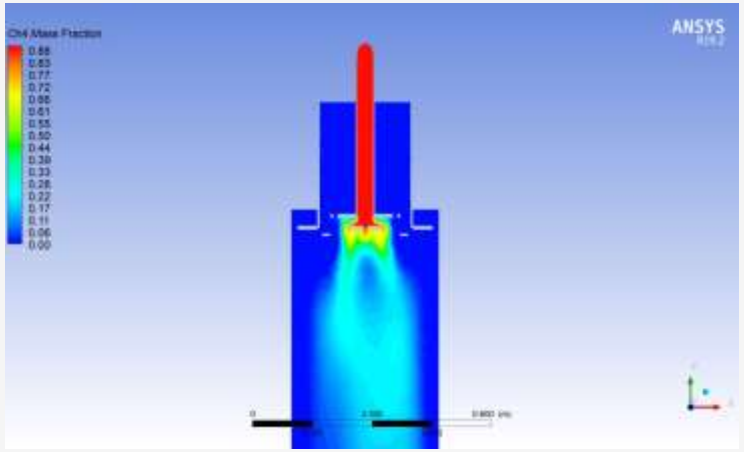
BURNER CFD (Computational Fluid Dynamics) Analysis





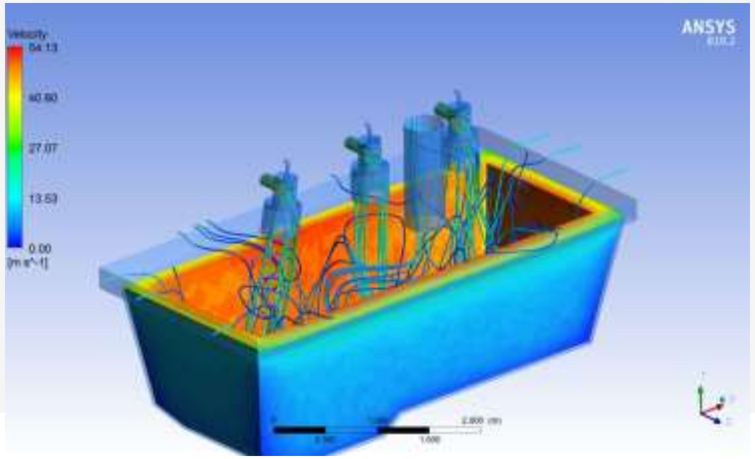


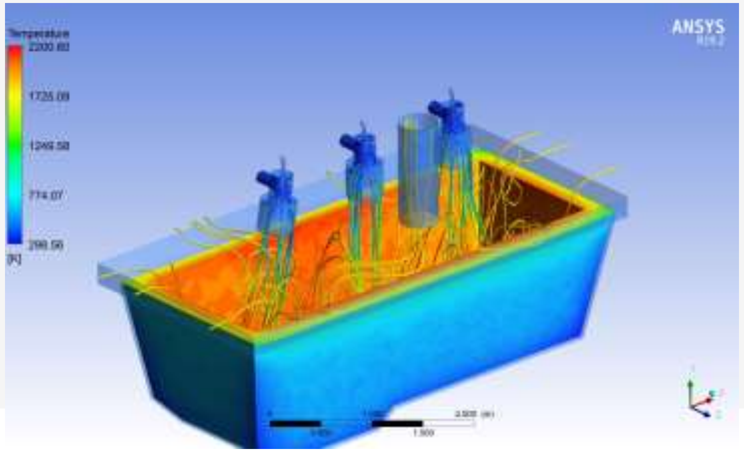
1 Burner Stream Line

2 Burner Flame Temperature

3 CH4 Distribution

4 Streamlines





Heating Systems CFD Modeling, Tests and Validations

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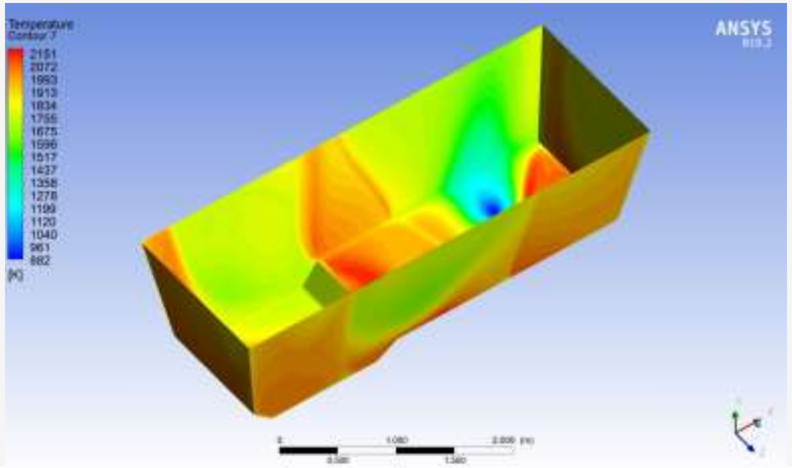
Data Validation has been started when the Burneres manufactured, a pilot tets facilities and the Burners has been tetsed in several operational conditions. The tests have been done under **CFD** team supervision and the results used as a feed back for our recalculations. Finally these tests, recalculations and computional analysis made some modifications on the Burners , Tundish and Laddle cover Refractorie's Enginieering & Design.



High- Solidity Axial Flow CFD Modeling

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High-Solidity Axial Flow Agitators are using for Bio-Leaching Bacteria preparation and Bio-Leaching Copper Extraction, We Use CFD modeling to design and make optimization on agitation Tanks with following targets:

1. Agitators >CFD Analysis to mechanical evaluations
2. Oxygen Dissolved Distribution
3. Air Spurger System size and installation Location
4. Velocity Vectors , Streamlines & Pressure Distribution

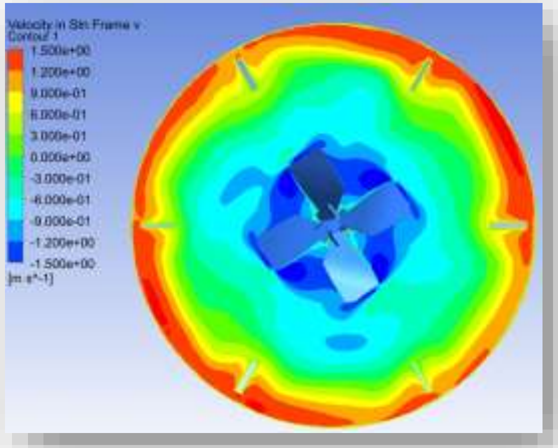

Figure 1. velocity (y-component) at blade plane section

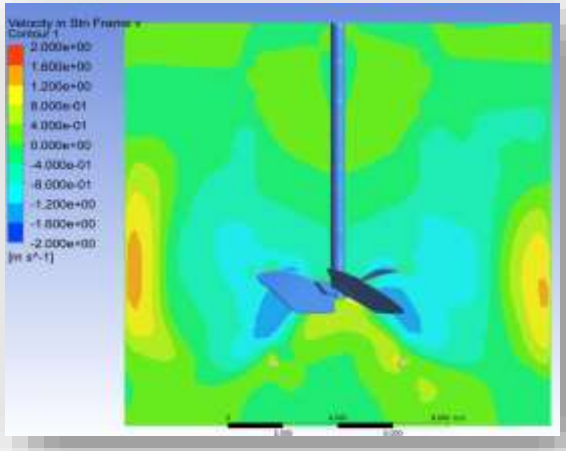

Figure 2. velocity (y-component) at symmetric plane (x=0)

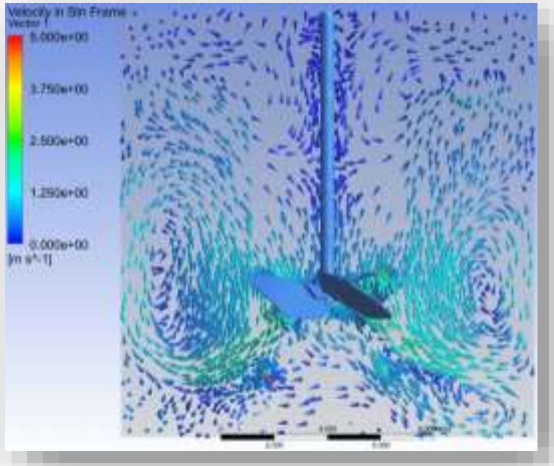

Figure 3. velocity vector at symmetric plane (x=0)

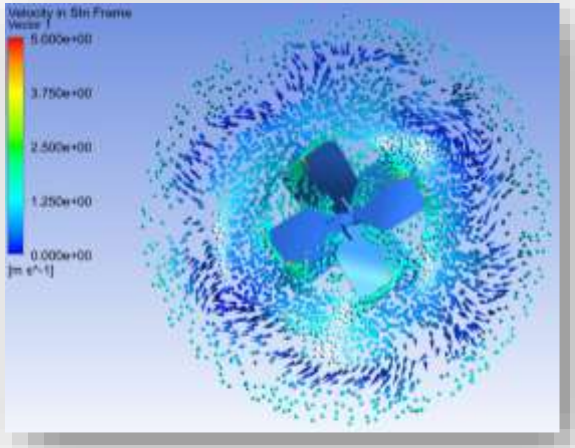

Figure 4. velocity vectors at blade plane section

High- Solidity Axial Flow CFD Modeling

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Agitators >CFD Analysis to Velocity Vectors Evaluations:

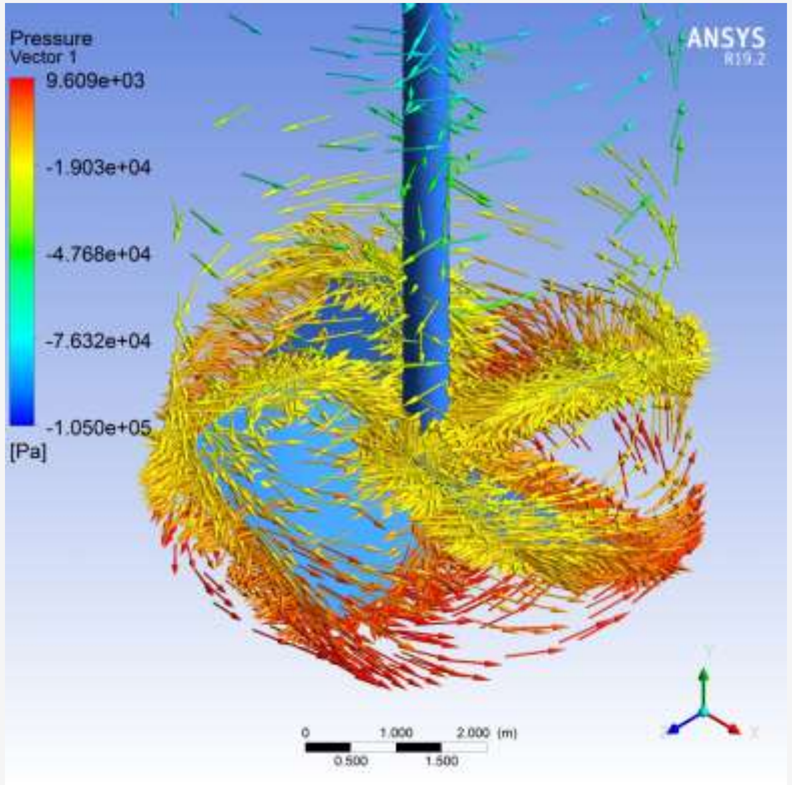

Figure 1. Velocity vectors around the impeller colored by the pressure (isometric view)

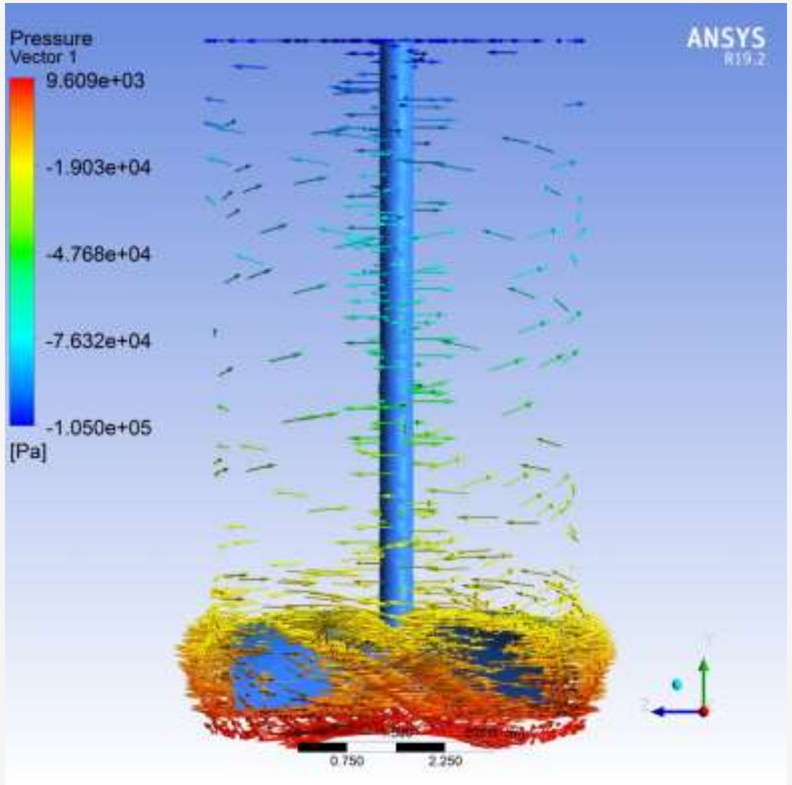

Figure 2. Velocity vectors around the impeller colored by the pressure (side view)

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Spurger >**CFD** Analysis to Air Ejection Evaluations:

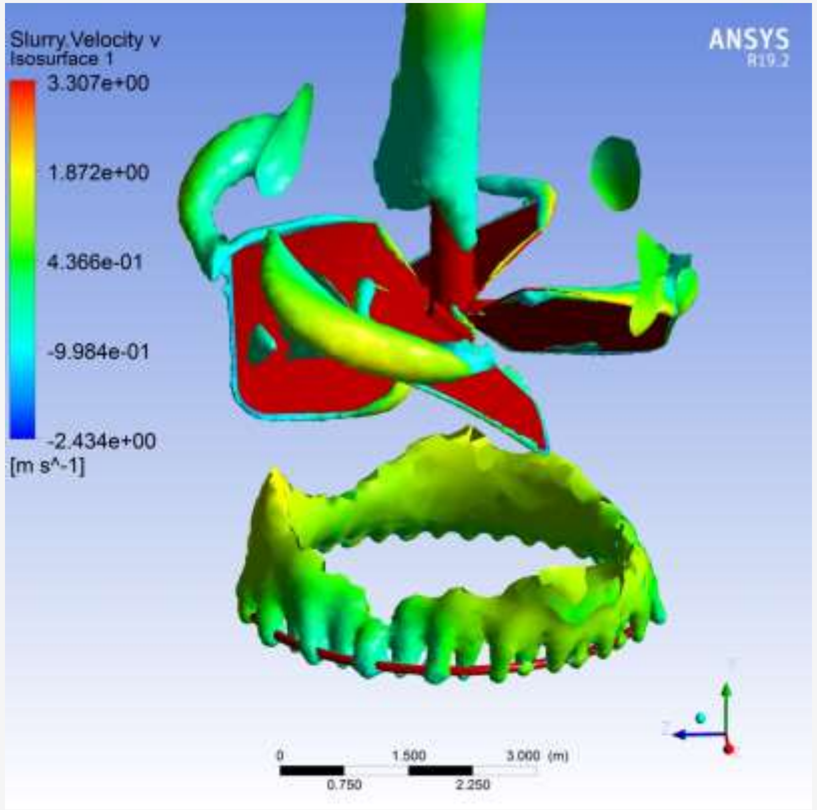

Figure 1. Iso-surface of injected air at volume fraction of 0.1, colored by axial velocity

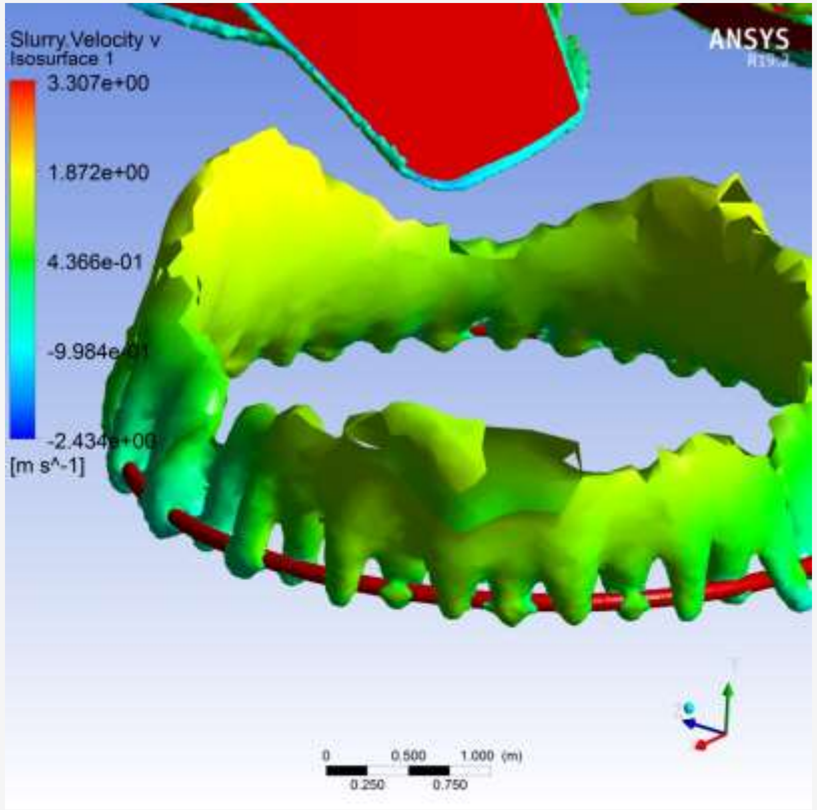

Figure 2. Iso-surface of injected air at volume fraction of 0.1, colored by axial velocity

High- Solidity Axial Flow CFD Modeling

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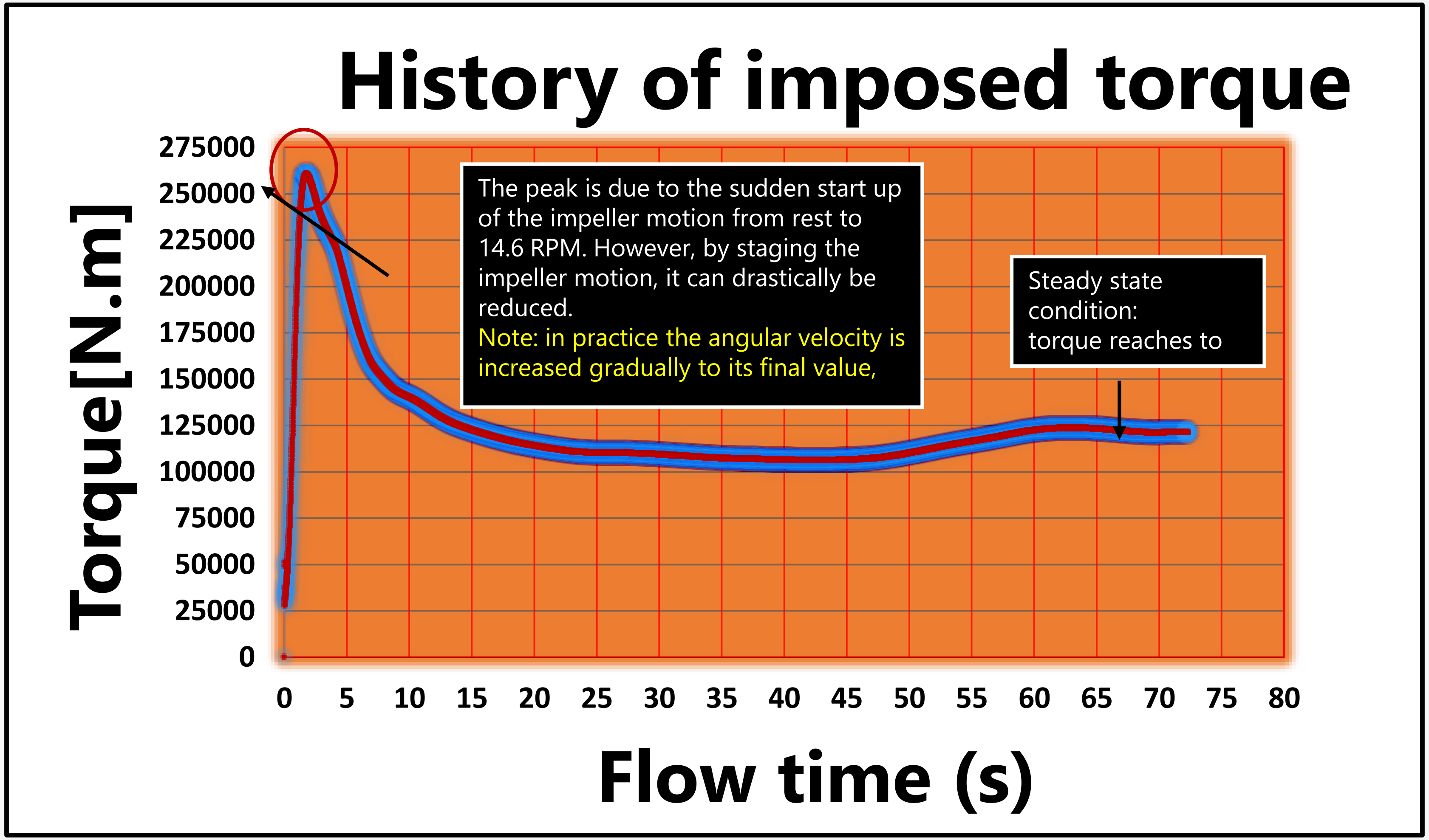
Agitators >CFD Analysis to mechanical evaluations :



Hi-Efficiency Impeller CFD Modeling

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Hi-Efficiency Impeller Agitators are using for Gold Leaching Extraction Process, We Use CFD modeling to design and make optimization on agitation Tanks with following targets:

1. Agitators >CFD Analysis to mechanical evaluations
2. Oxygen Dissolved Distribution
3. Velocity Vectors , Streamlines & Pressure Distribution

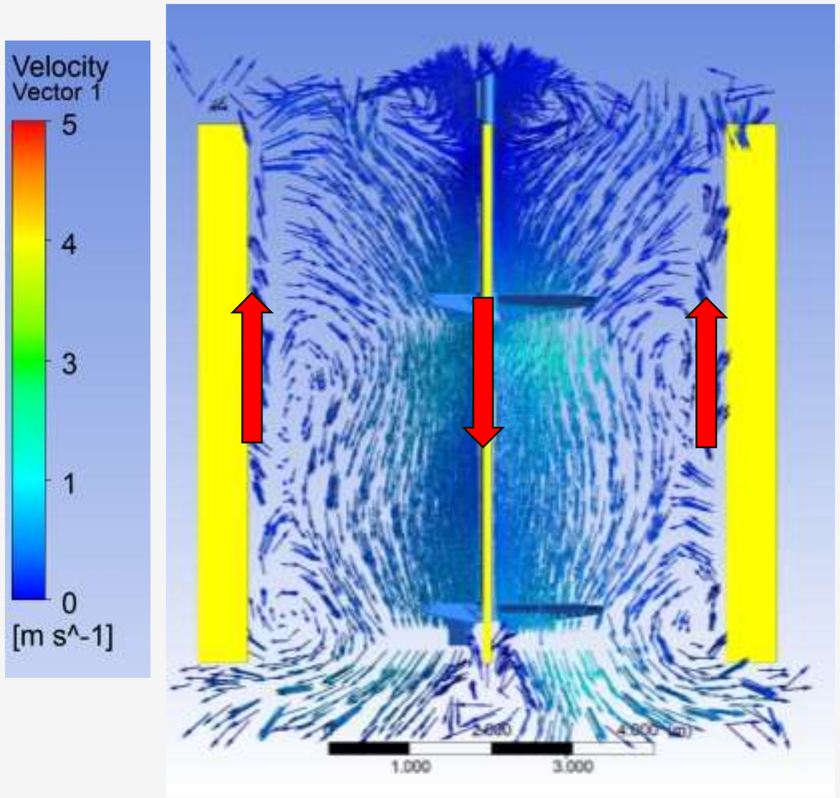

Figure 1. velocity vector at symmetry plane (x=0)

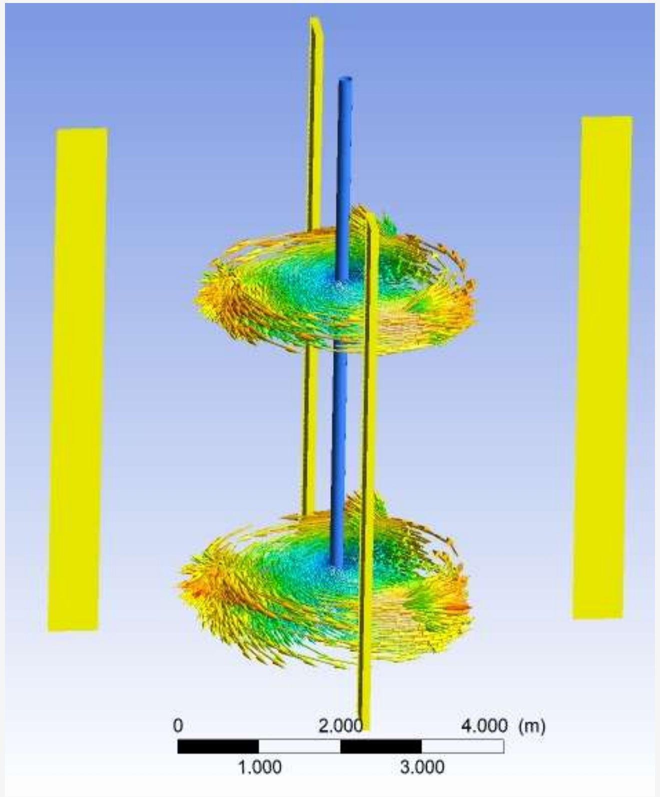

Figure 2. velocity vectors in blade zones

Downward motion at the center of the tank and upward motion near walls of the tank

Hi-Efficiency Impeller CFD Modeling

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Agitators **>CFD** Analysis to Velocity Vectors Evaluations:

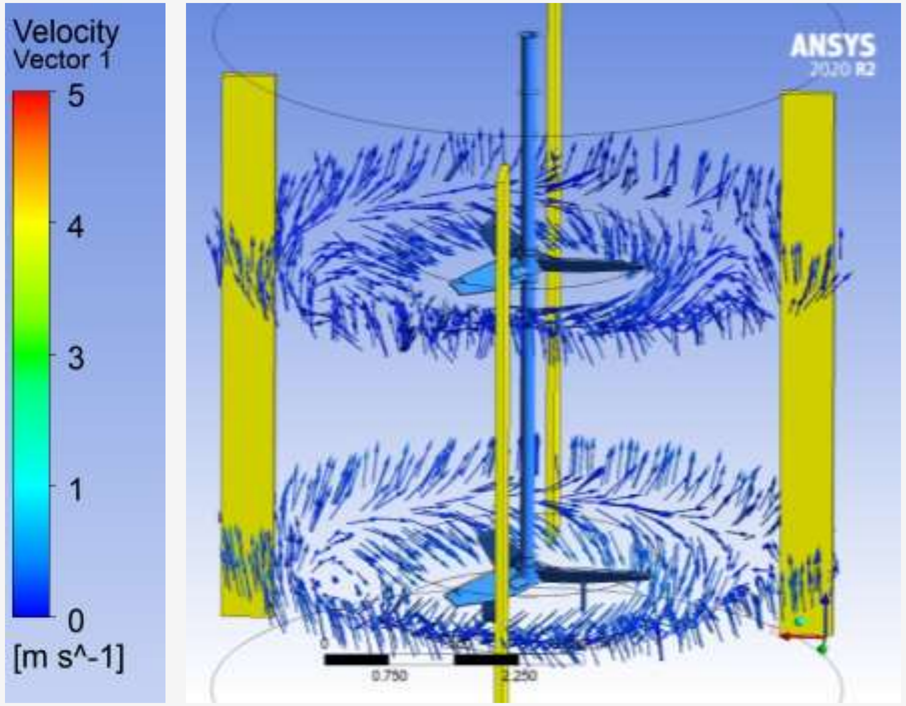

Figure 1. velocity vector around blades

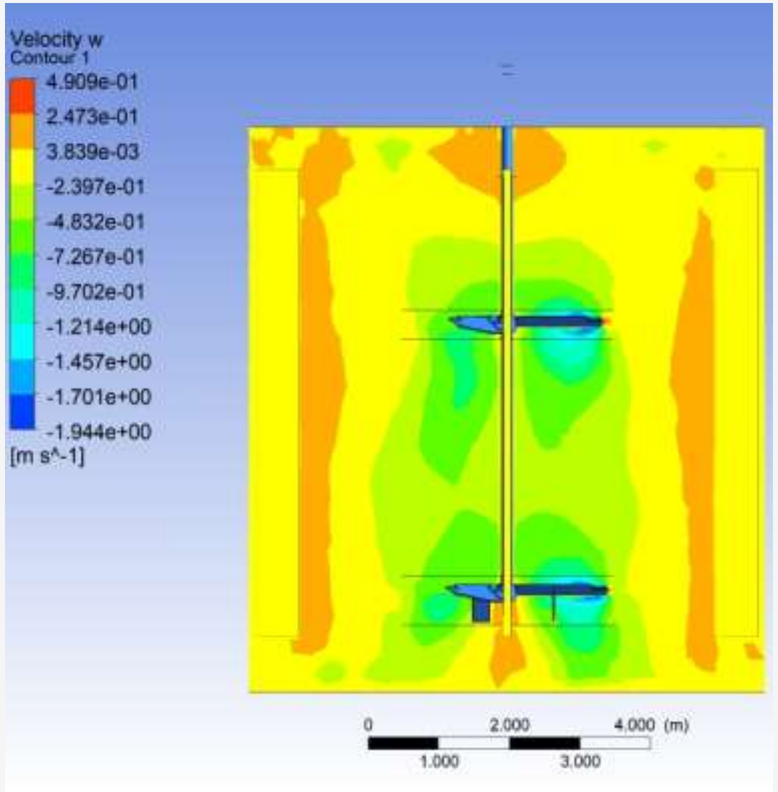

Figure 2. velocity contours of vertical velocity (z-component)

Negative vertical velocity at the center of the tank compared with the positive ones near walls. Upward velocity of 0.247 m/s compared with rule of thumb design calculations value of 0.42 m/s.

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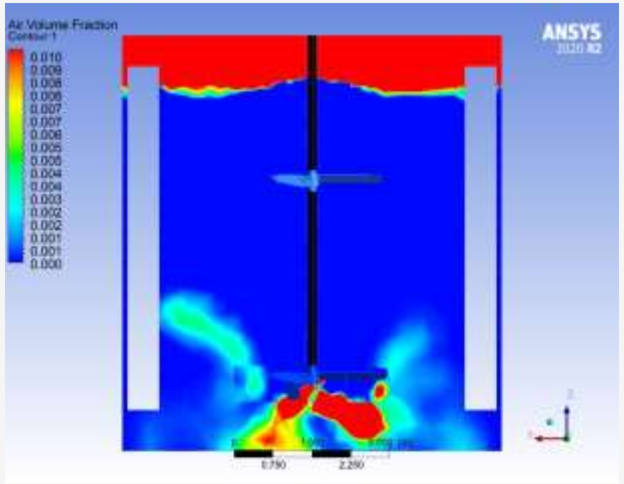

Figure 1. Contour of air volume fraction at symmetry plane section (<0.01 m3 air/m3 water) (DO ≤ 2 (mg/Lit))

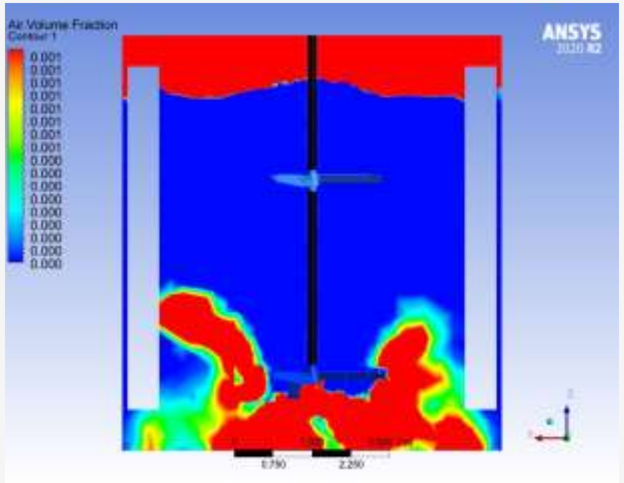

Figure 2. Contour of air volume fraction at symmetry plane section (<0.001 m3 air/m3 water) (DO ≤ 0.2 (mg/Lit))

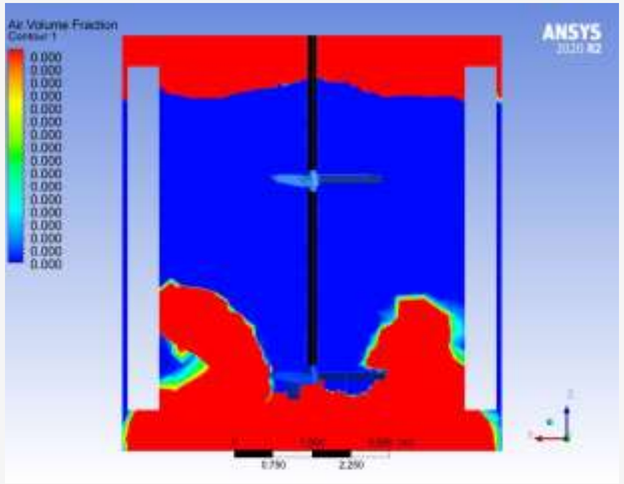

Figure 3. Contour of air volume fraction at symmetry plane section (<0.0001 m3 air/m3 water) (DO ≤ 0.02 (mg/Lit))

Center Shaft >**CFD** Analysis to Air Ejection Evaluations:

Blue: Low volume fraction of air

Red: High volume fraction of air

DO distribution may or may not fulfill chemical reaction needs.

Hi-Efficiency Impeller CFD Modeling

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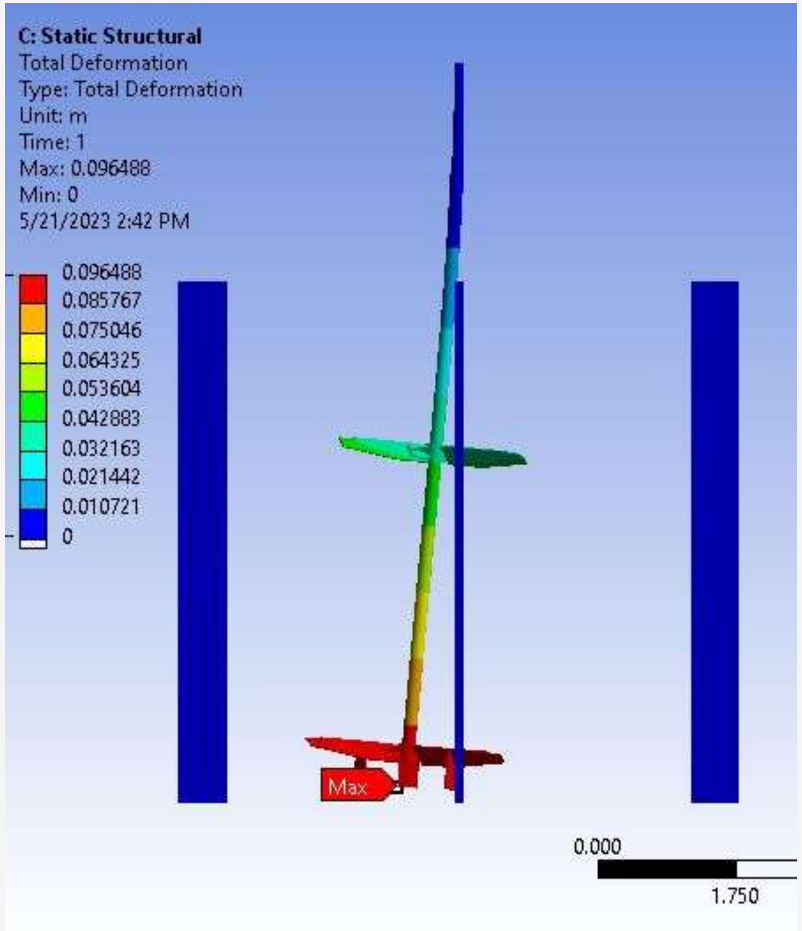
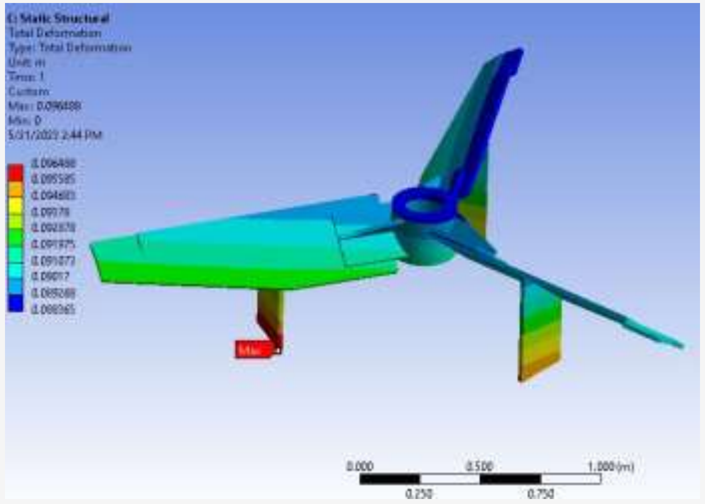
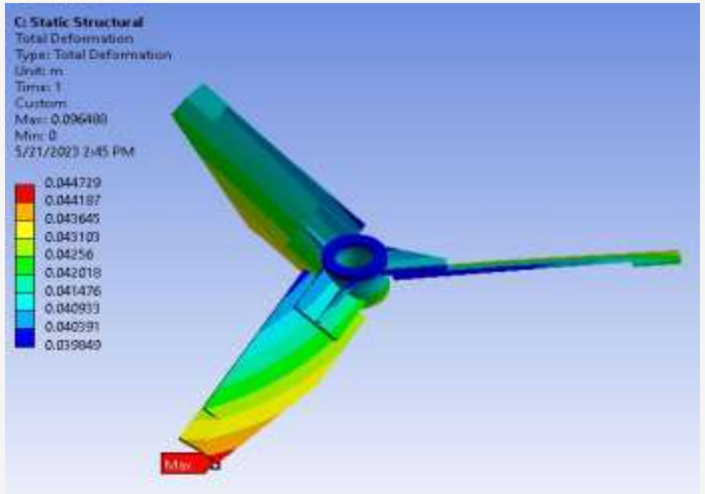
Agitators >CFD Analysis to mechanical evaluations :



It seems that there is an unsymmetric bending on the shaft.





FLUID FLOW of MINE TAILINGS in DISTRIBUTION TANK

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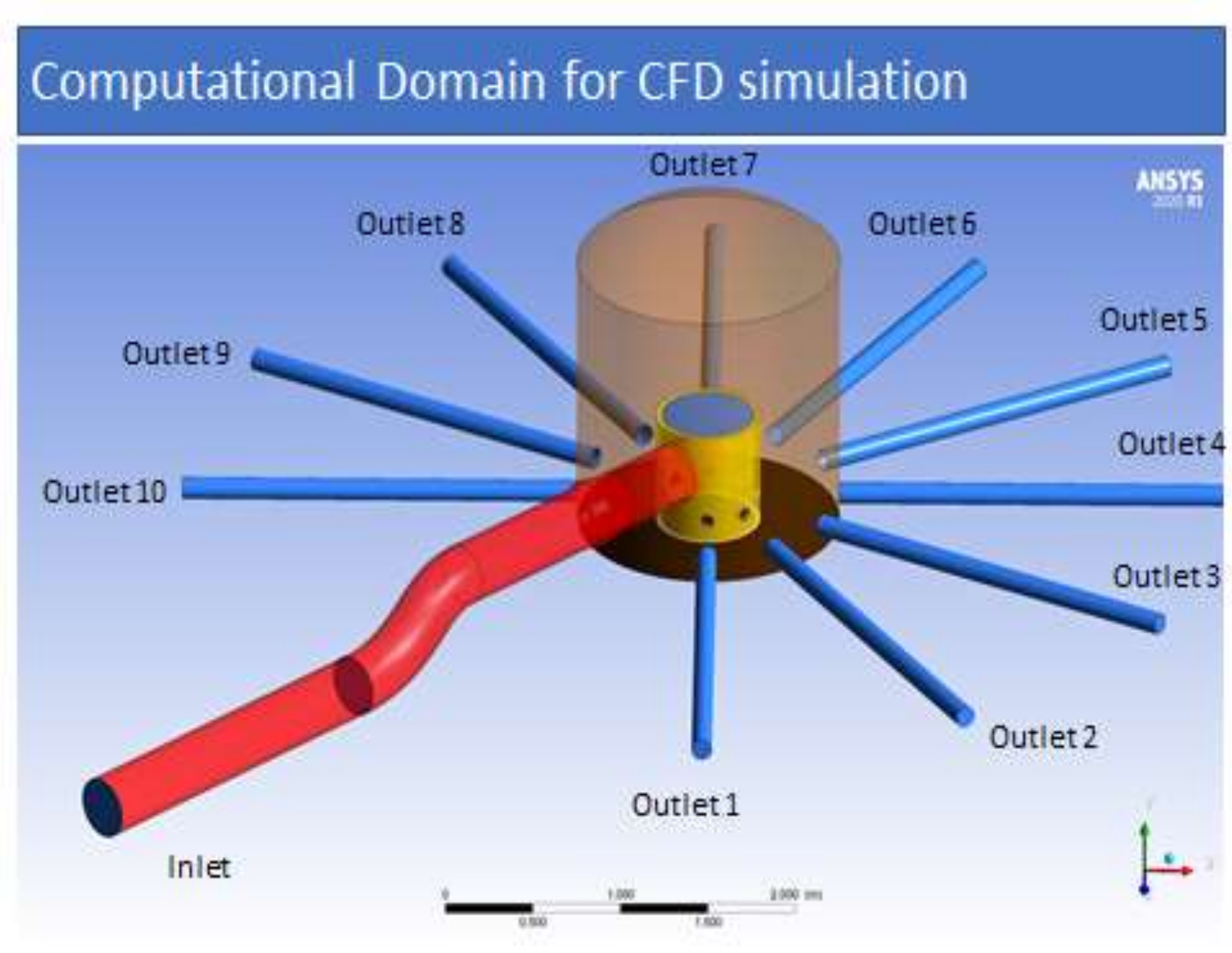
In this project CFD simulations were used to model the behaviour of tailings in distributions tank. Special interest in modelling was to study the Material deposition in the dead zones. Modelling was done in a simplified 3-dimensional geometry. The Front Figure shows the schematic drawing of the modelling domain.

1. Distributer >**CFD** Analysis to Deposition Dead Zones
2. Pressure Distribution
3. Velocity Distribution on Outlet Orifice
4. The Result is selecting the Orientation of the output nozzles and the size of the orifice



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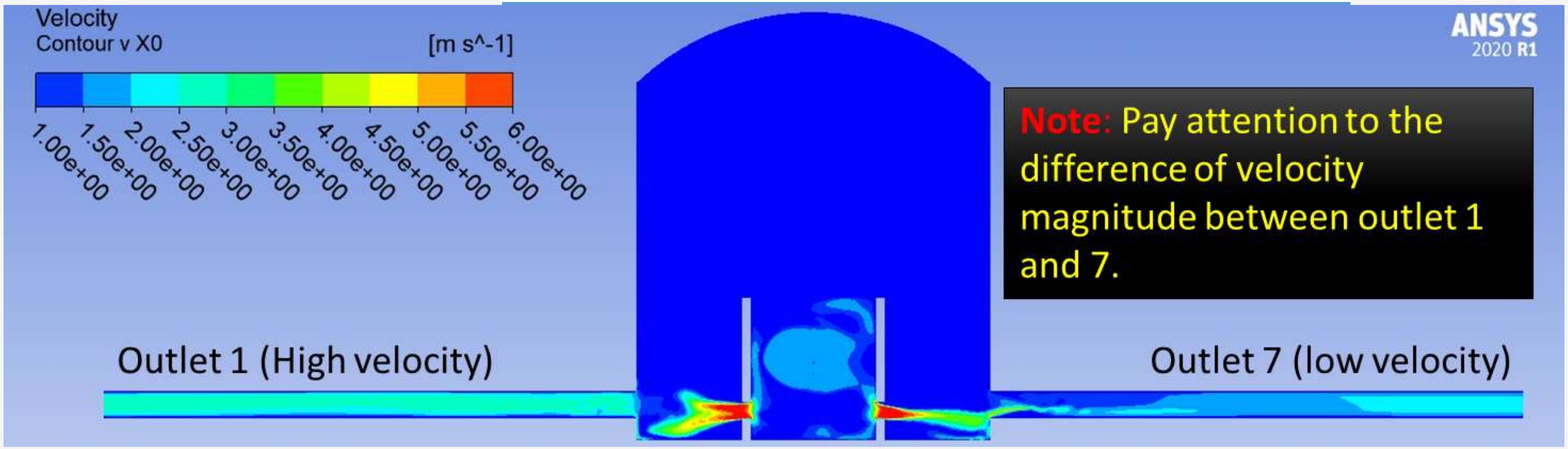

Velocity Distribution on Outlet Orifice

Velocity contour on plane z=0

FLUID FLOW of MINE TAILINGS in DISTRIBUTION TANK

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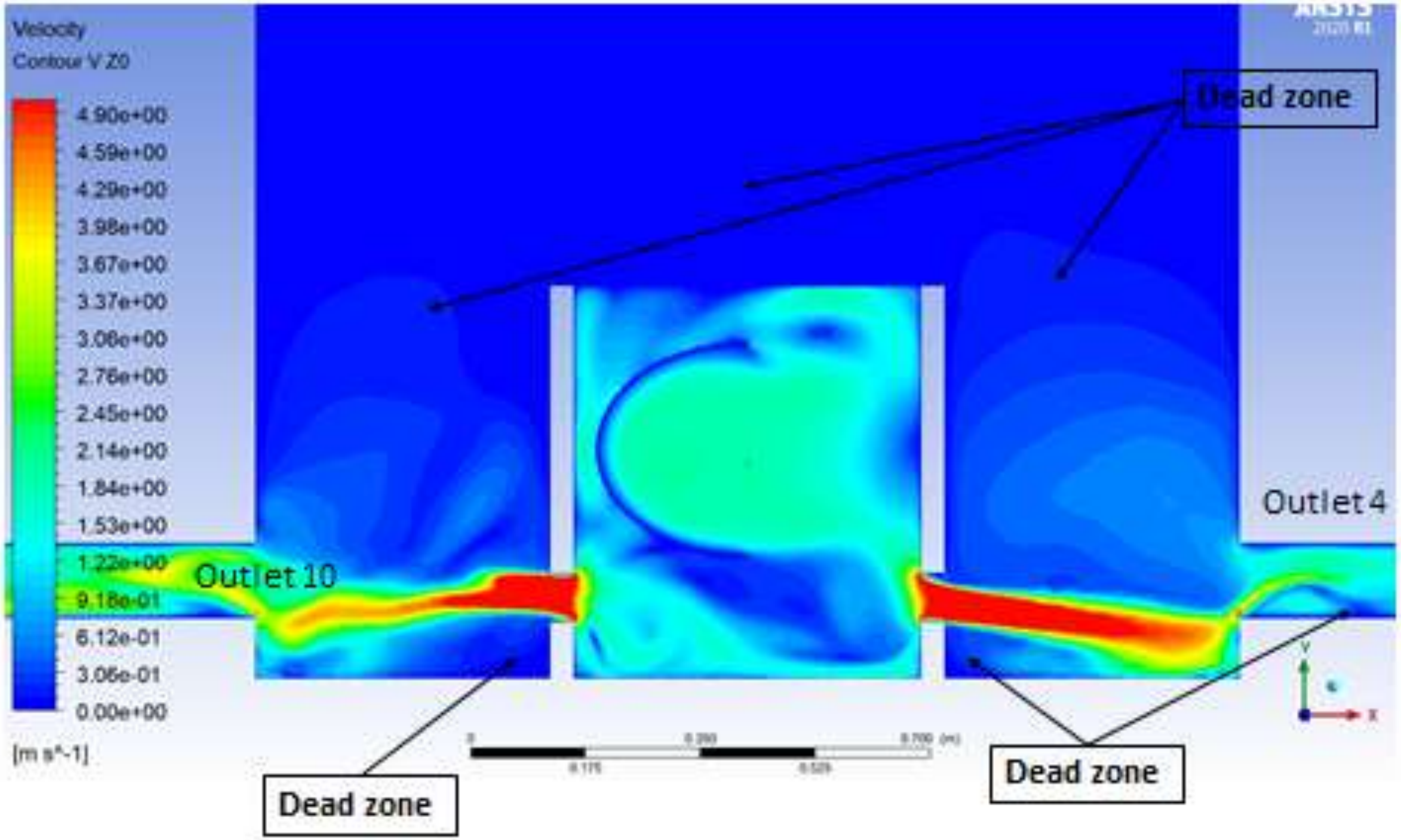
close-up view
Velocity contour on plane z=0 with focus on dead zones



Dead Zone Distribution

FLUID FLOW of MINE TAILINGS in DISTRIBUTION TANK

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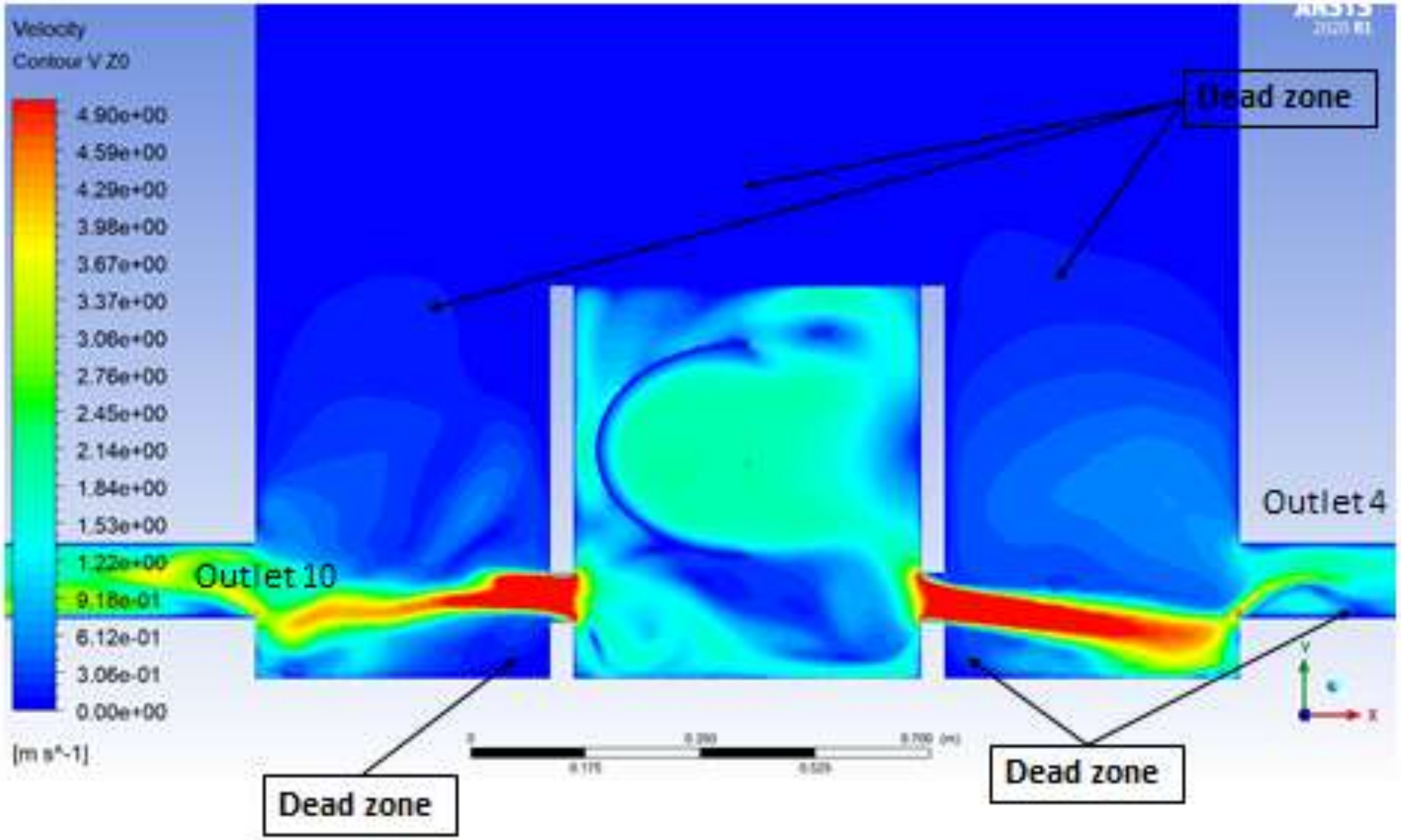
close-up view
Velocity contour on plane z=0 with focus on dead zones



Dead Zone Distribution

FLUID FLOW of MINE TAILINGS in DISTRIBUTION TANK

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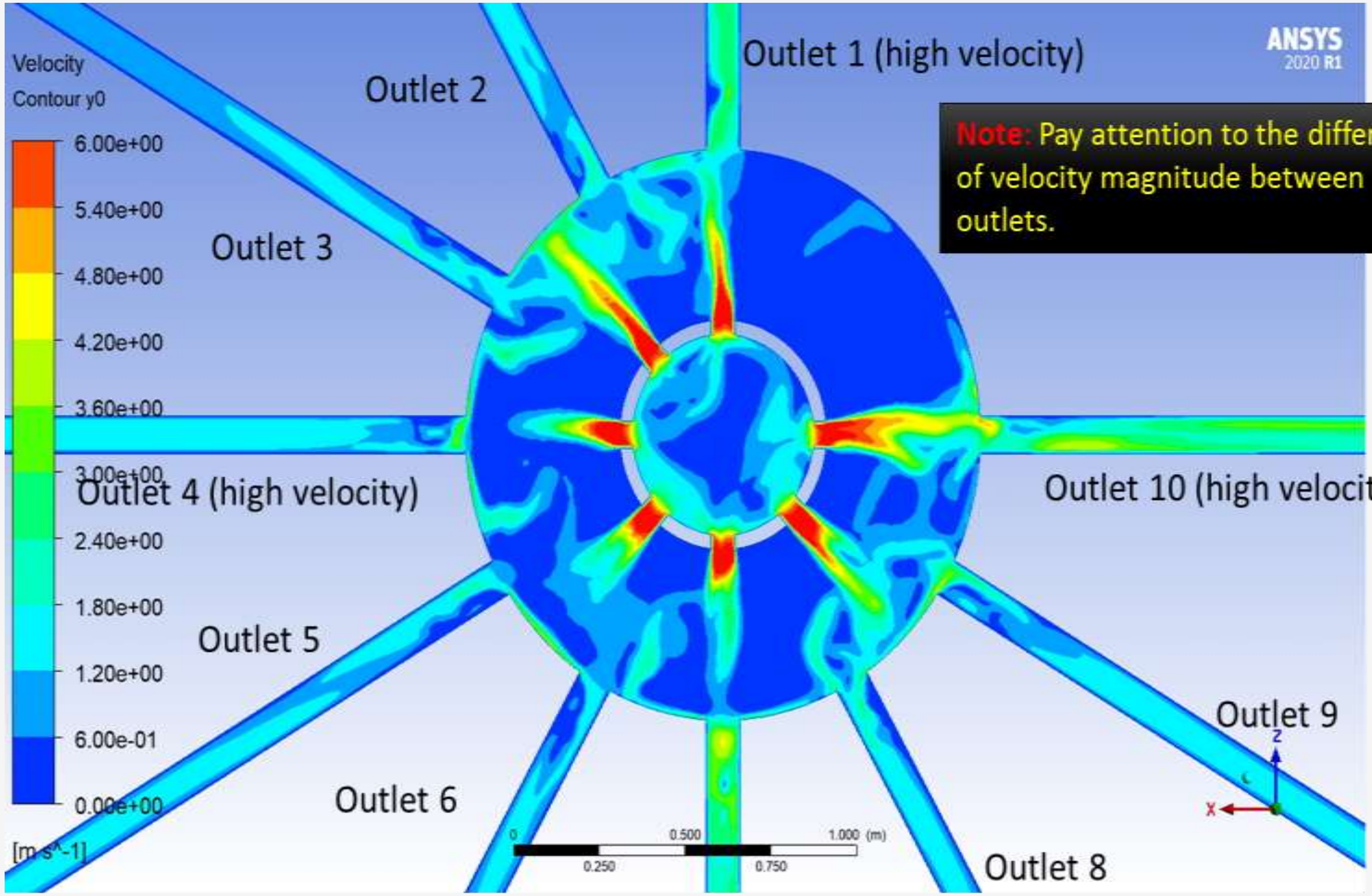
close-up view
Velocity contour on plane Y=0 with focus on dead zones



Velocity contour on plane y=0

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Thanks for your Attentions