InSGeP

Valorization of EAF slags from DRI melting with dry granulation process

Marta Guzzon - Tenova

05/03/2025

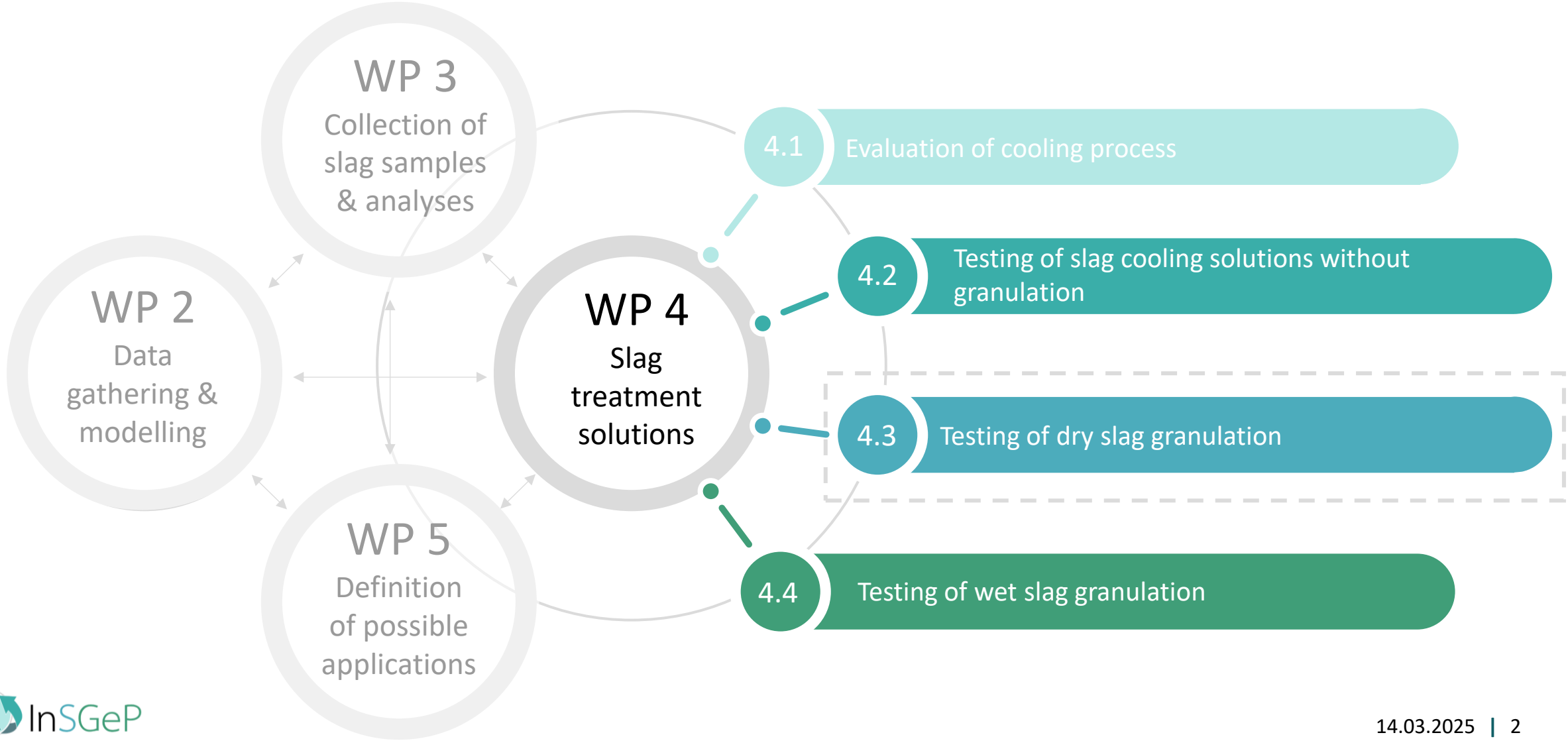
Event title

European Commission

The research leading to these results has received funding from the European Union's Research Fund for Coal and Steel research programme under grant agreement number: 101112665

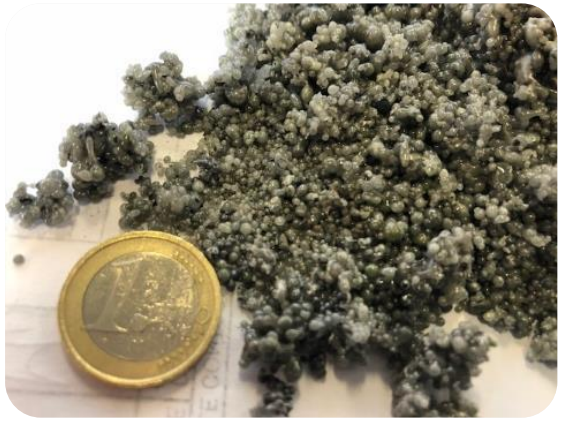
Project Structure

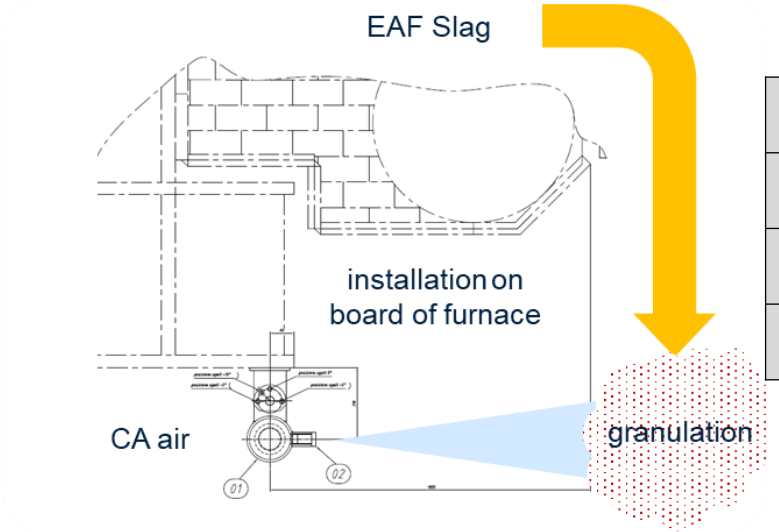
WP4 – Slag Treatment Solutions



Tenova Dry Slag Granulation

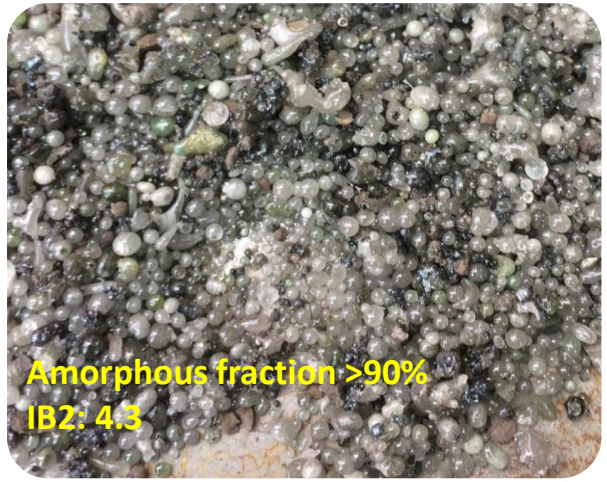
On Line: EAF slag directly in the pit

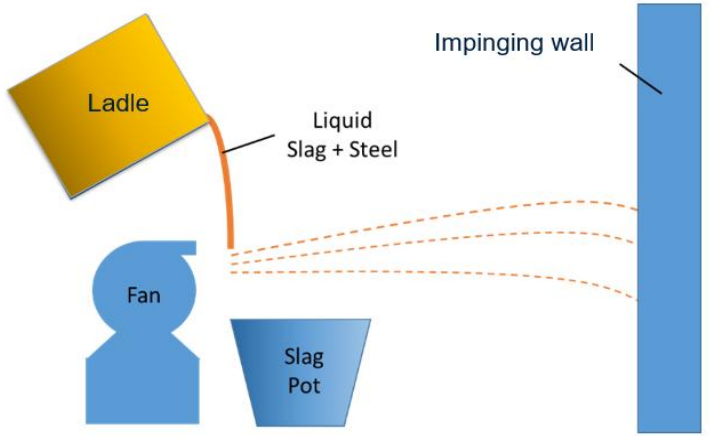




Type	Industrial
Application	On Line
Slag	EAF Slag
Slag Flow Rate	variable

Off-Line: EAF slag in slag pot and LF slag in ladle





Type	Pilot
Application	Off line
Slag	LF Slag + steel*
Slag Flow rate	Controlled (costant)

Tenova Dry Slag Granulation Modelling

6- Restart with semi-empirical correlation or using CFD

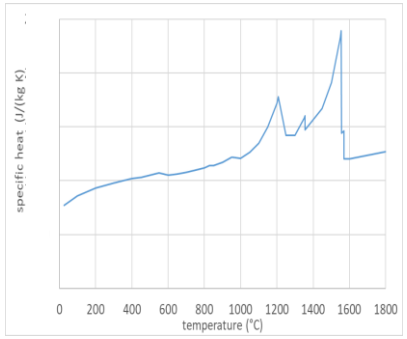
1- Definition of the chemical and physical properties of the slag

2- Design of the fan size and the definition of the working points

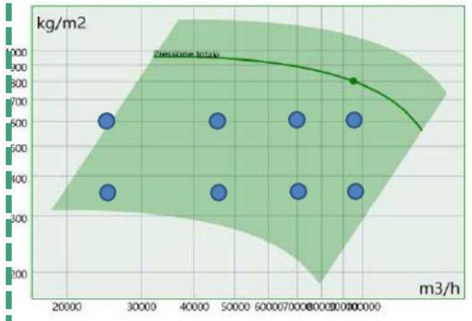
3- Granulometry Simulation (semi-empirical / CFD)

4- Computation Fluid Dynamic Modelling

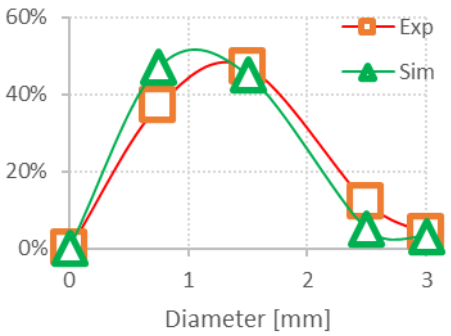
5- Pilot test



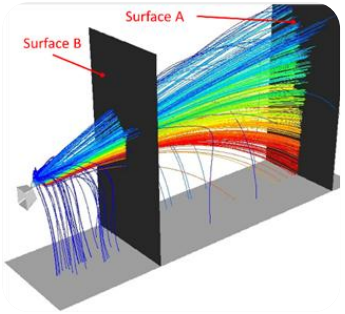
Rina-CSM
Slag Properties Models



Tenova
Process Definition



Tenova
Granulometry Definition



Tenova
CFD
Particle Trajectory/ Cooling

Rina-CSM
Validation

Slag properties

Slag properties given by CSM:

100% DRI FEED		SLAG COMPOSITION	
Chemical compound	**% WEIGHT**	**Species**	**% WEIGHT**
Fetot.	84.4	SiO_2	18.7
Al_2O_3	1	TiO_2	1.3
CaO	1.2	CaO	37.1
MgO	0.7	MgO	6.9
SiO_2	4.7	FeO	24.1
ZnO	0.03	MnO	1.6
S	0.01	Al_2O_3	9.4
C	3.3	Na_2O	0.5
Metallization	95.5	K_2O	0.2

100% DRI

Temperature	1550	°C
Density @T	3081	Kg/m3
Surface tension @T	0.539	N/m
Viscosity @T	0.0261	Pa*s
Thermal conductivity @T	0.08	W/m/K
Specific heat @T	1401	J/kg/K

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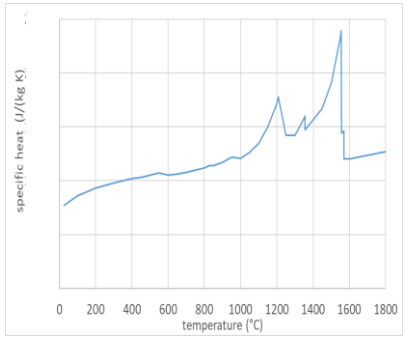
1- Definition of the chemical and physical properties of the slag

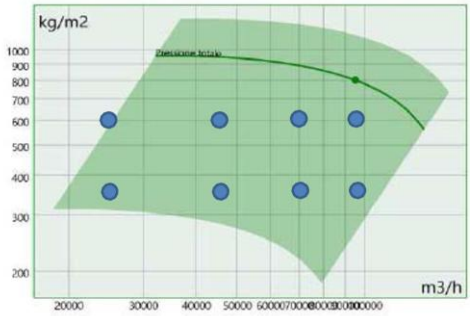
2- Design of the fan size and the definition of the working points

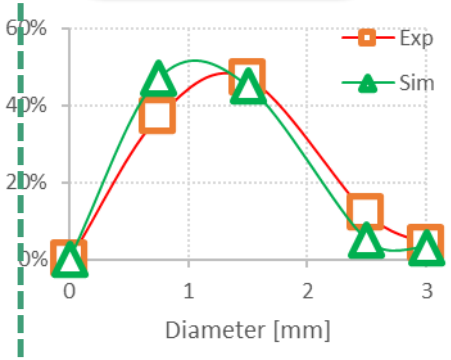
3- Granulometry Simulation (semi-empirical / CFD)

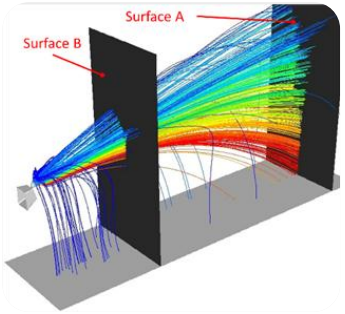
4- Computation Fluid Dynamic Modelling

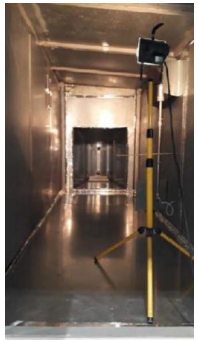
5- Pilot test











Rina-CSM
Slag Properties Models

Tenova
Process Definition

Tenova
Granulometry Definition

Tenova
CFD
Particle Trajectory/ Cooling

Rina-CSM
Validation

Model setup

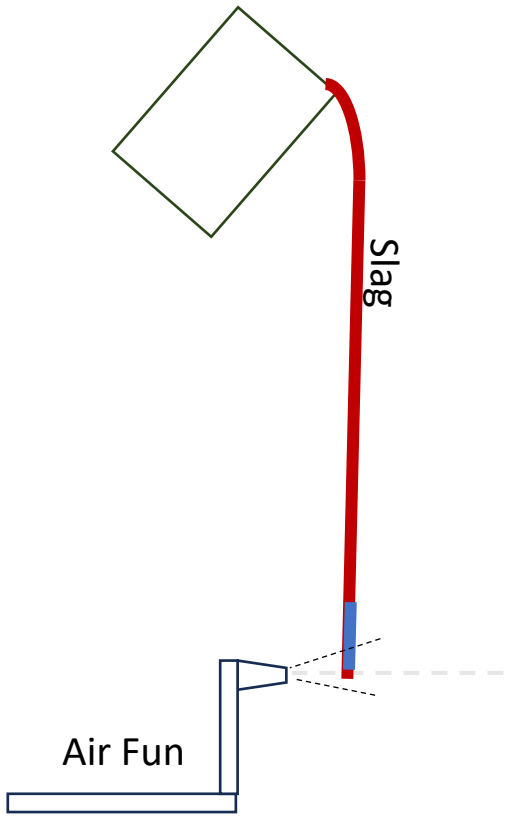
The system is described in a transient way by means of a multiphase model called VOF-to-DPM. The energy is enabled and the turbulence model used is the κ-ω SST.

VOF (Volume Of Fluid) – to – DPM (Discrete Phase Model)

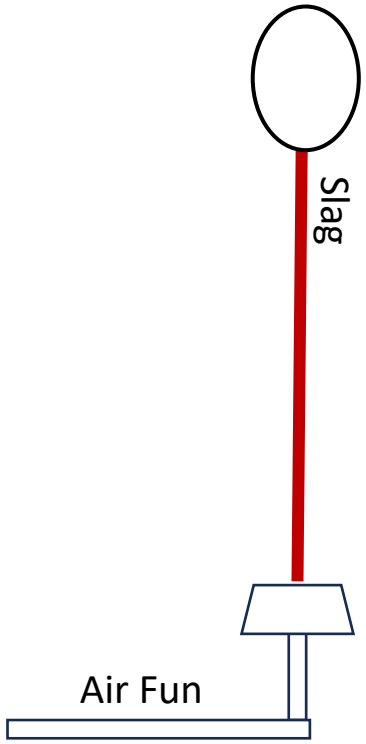
- ✓ Jet initial description (tracking liquid-gas interface)
- ✓ Capture instabilities and large structures formation (**primary breakup**)
- ✓ Explicit spray description from atomization to dispersion with a computationally intensive approach (*long* computation time)
- ✓ The **inputs are based on the process conditions** (such as the slag mass flow rate)
- ✓ The dispersion phase **(DPM) consists in the spherical droplets** formed during primary breakup
- ✓ **The output is the granulometry**, temperature and properties of the individual particles

Granulation Process – Geometry

Side view*



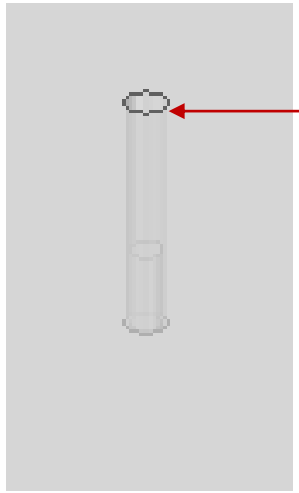
Front view



Plant view

*draw made by CSM

Boundary Condition

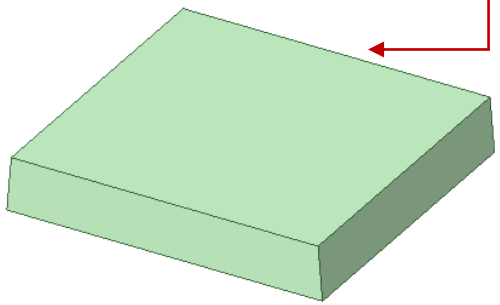


Inlet Slag

Mass Flow Inlet

m

T **1550** °C

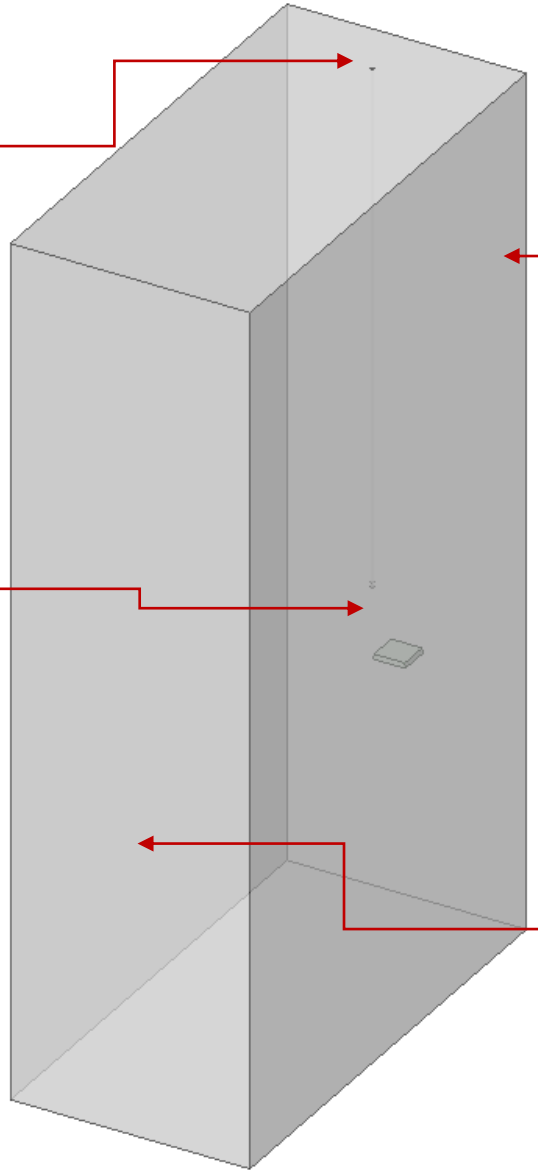


Inlet Air

Velocity Inlet

v

T **25** °C



Wall

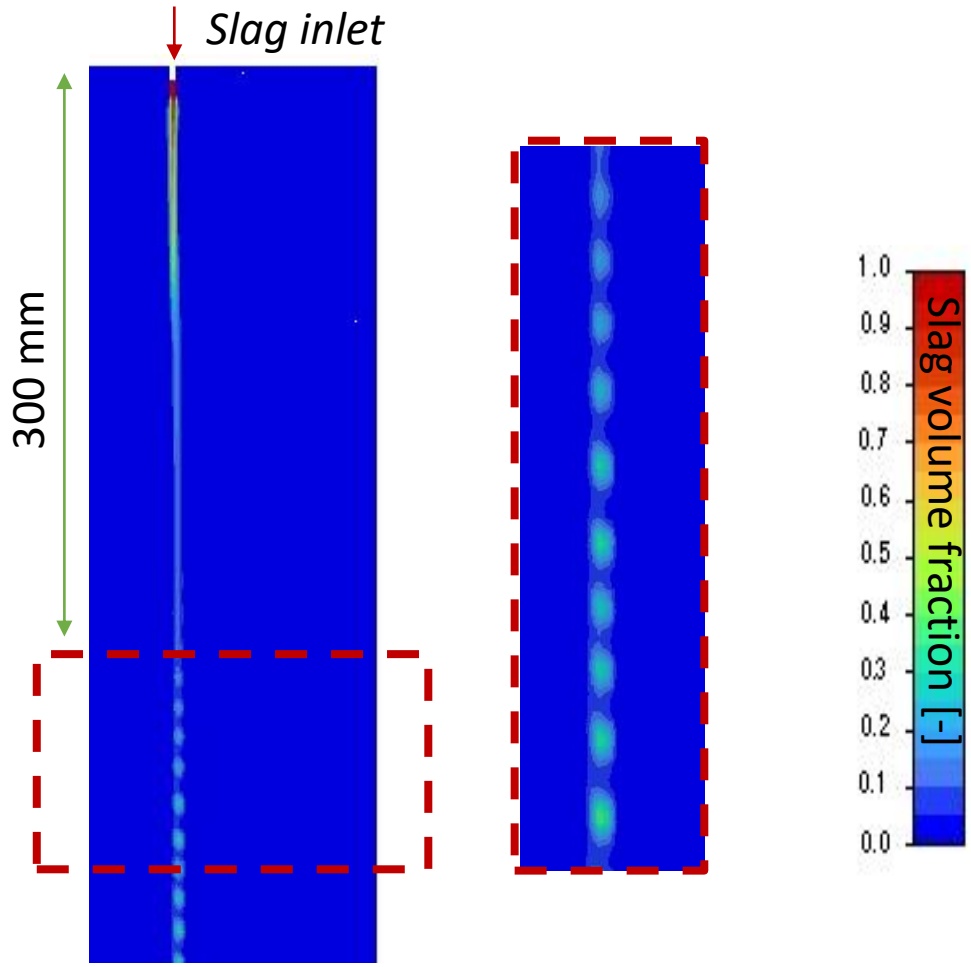
Outlet (Back)

Pressure Outlet

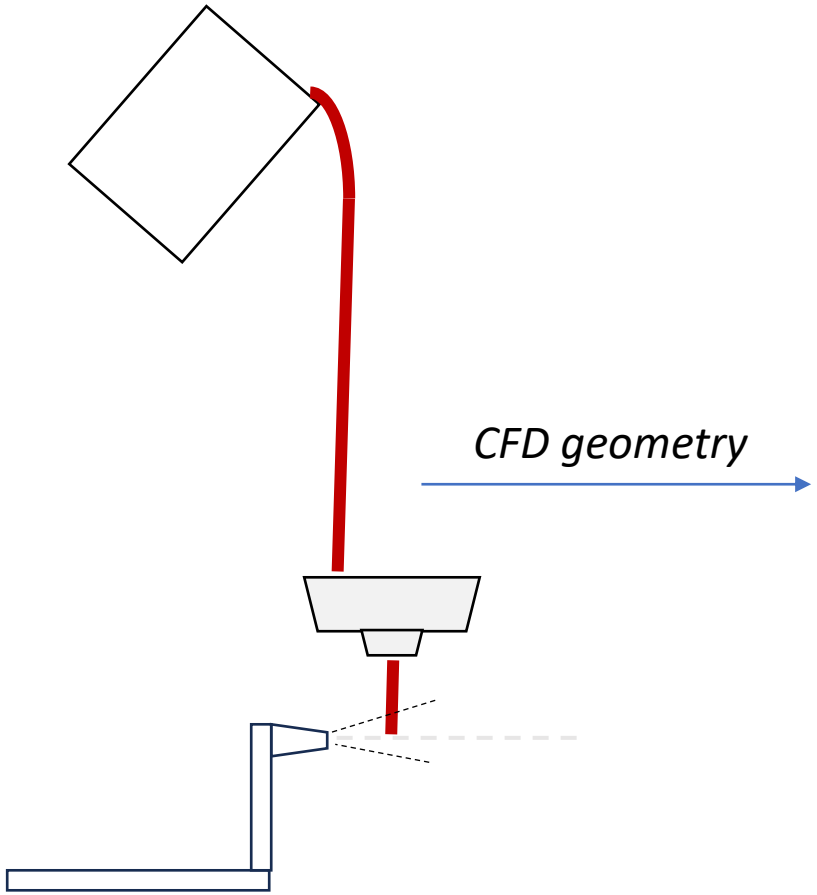
Simulation of the actual configuration

The CFD simulation with the CSM's geometry gives:

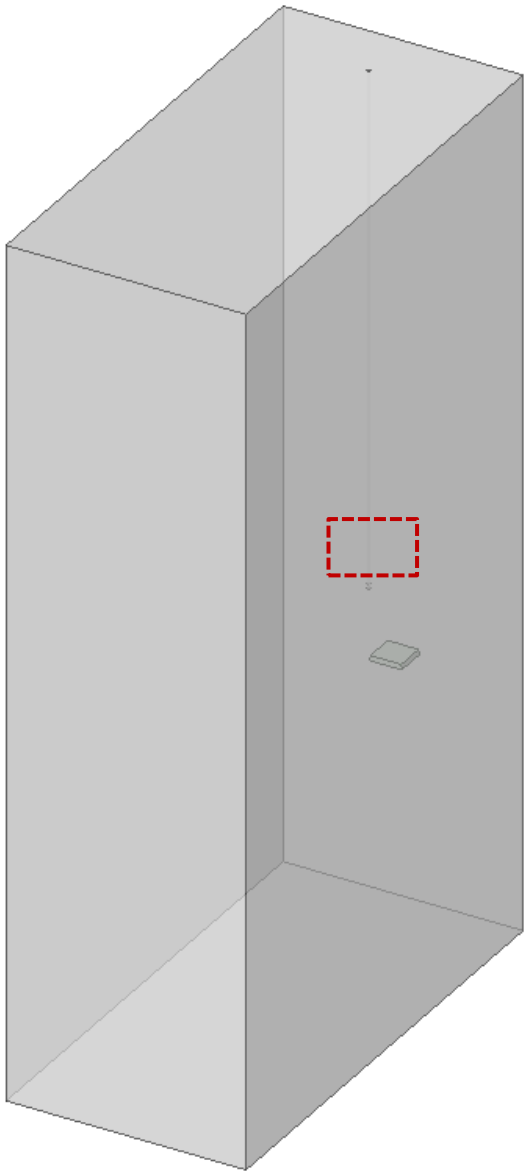
- a jet with a strong ***instability*** due to the distance between the point of slag release and the air nozzle
- The work conditions are ***unusual*** compared to the well know plant conditions



Simulation of New Configuration



CFD geometry



In order to be closer to the standard granulation conditions and to achieve a stable jet, a new plant configuration was proposed by CSM.

The main difference is the introduction of a '***slag tundish***' that allows to obtain a more stable jet with a higher diameter.

The CFD geometry is different by means:

- Position of the slag inlet
- Diameter of the slag inlet

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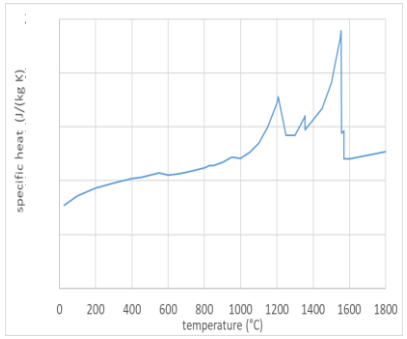

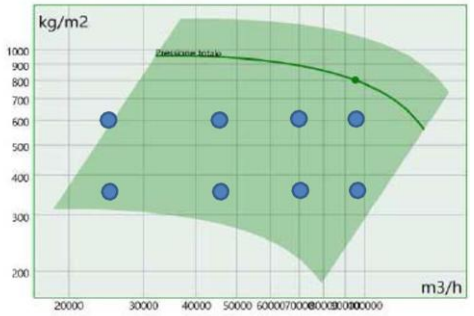

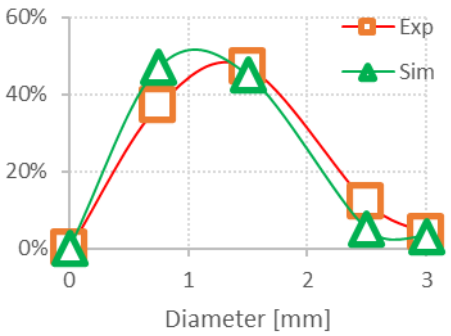

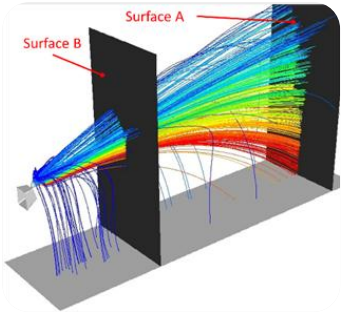

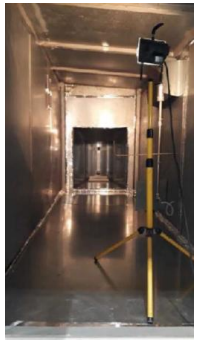

Rina-CSM
Slag Properties Models

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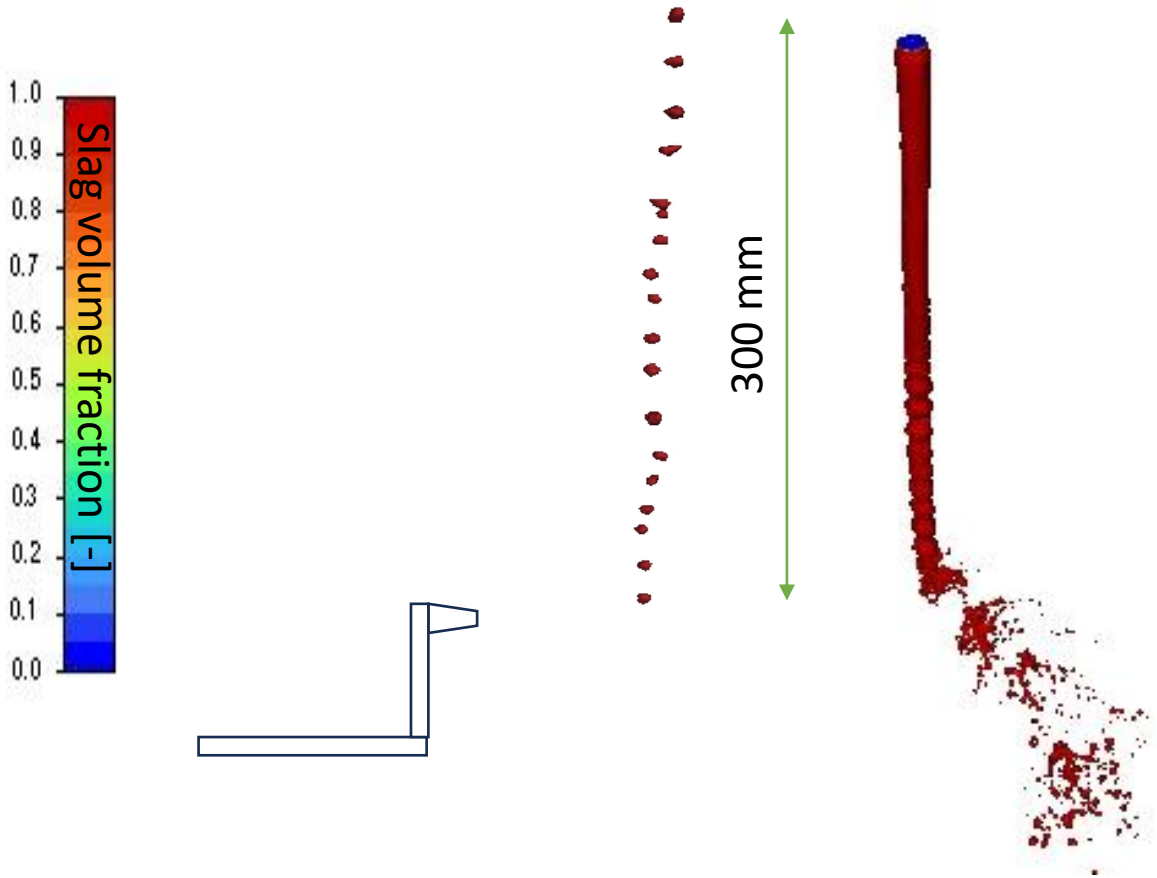
Validation

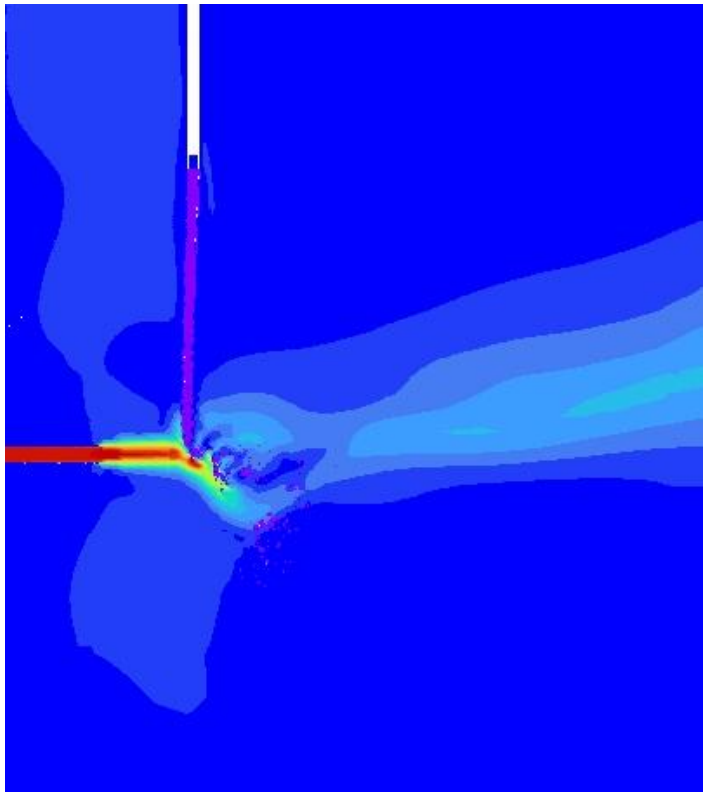
Simulation of New Configuration

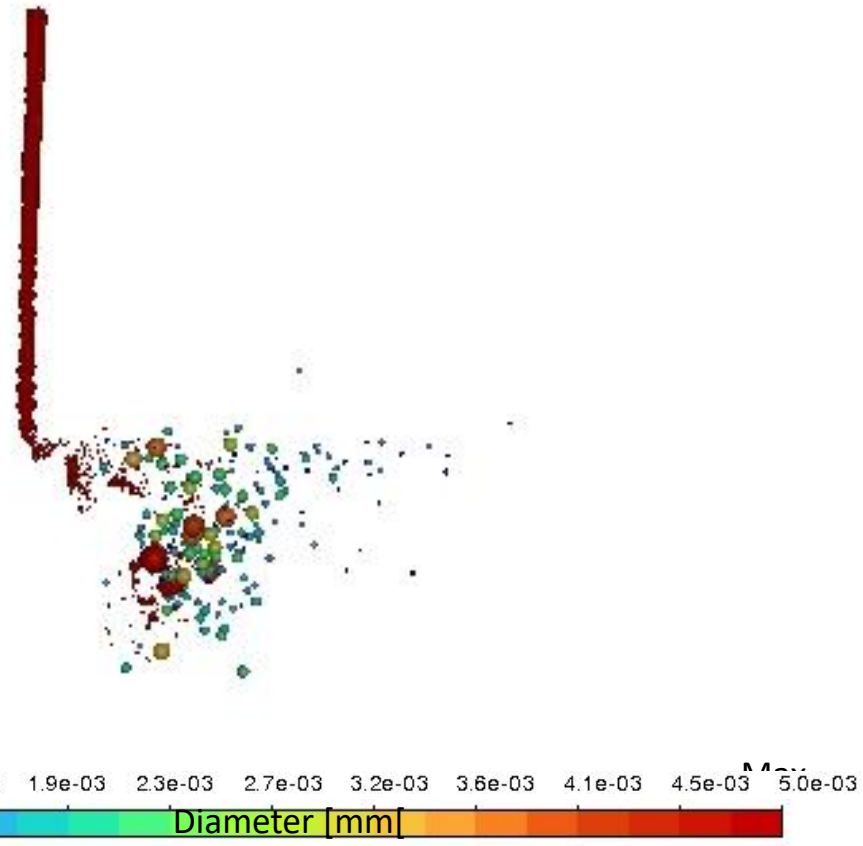
Old configuration **New configuration**



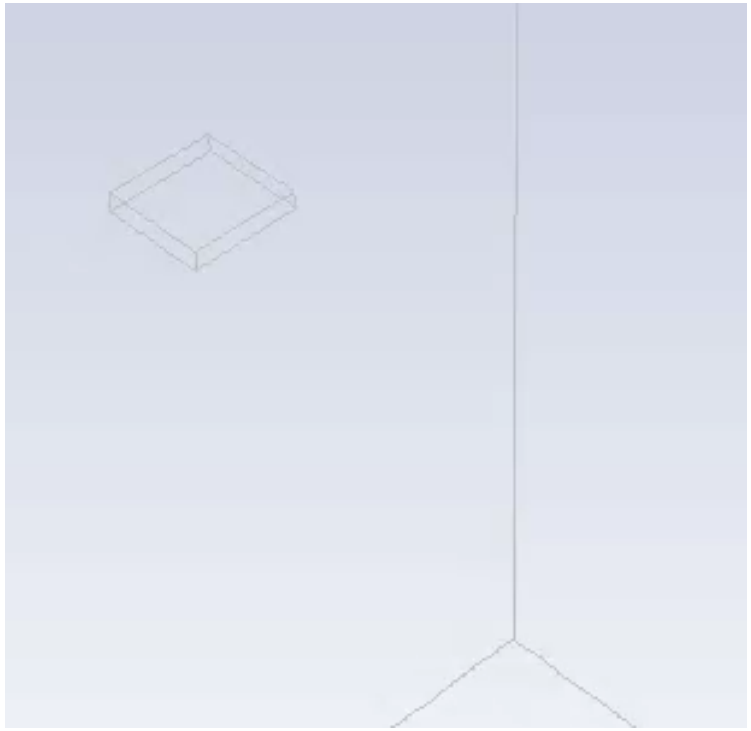
The CFD results confirm the success of the new configuration in terms of jet stability.

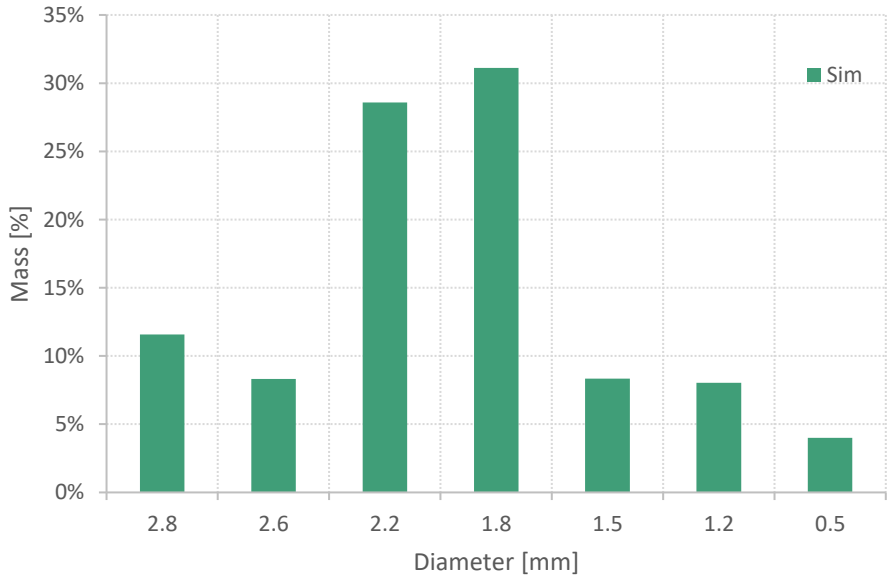
Simulation of New Configuration





Simulation of New Configuration - RESULTS

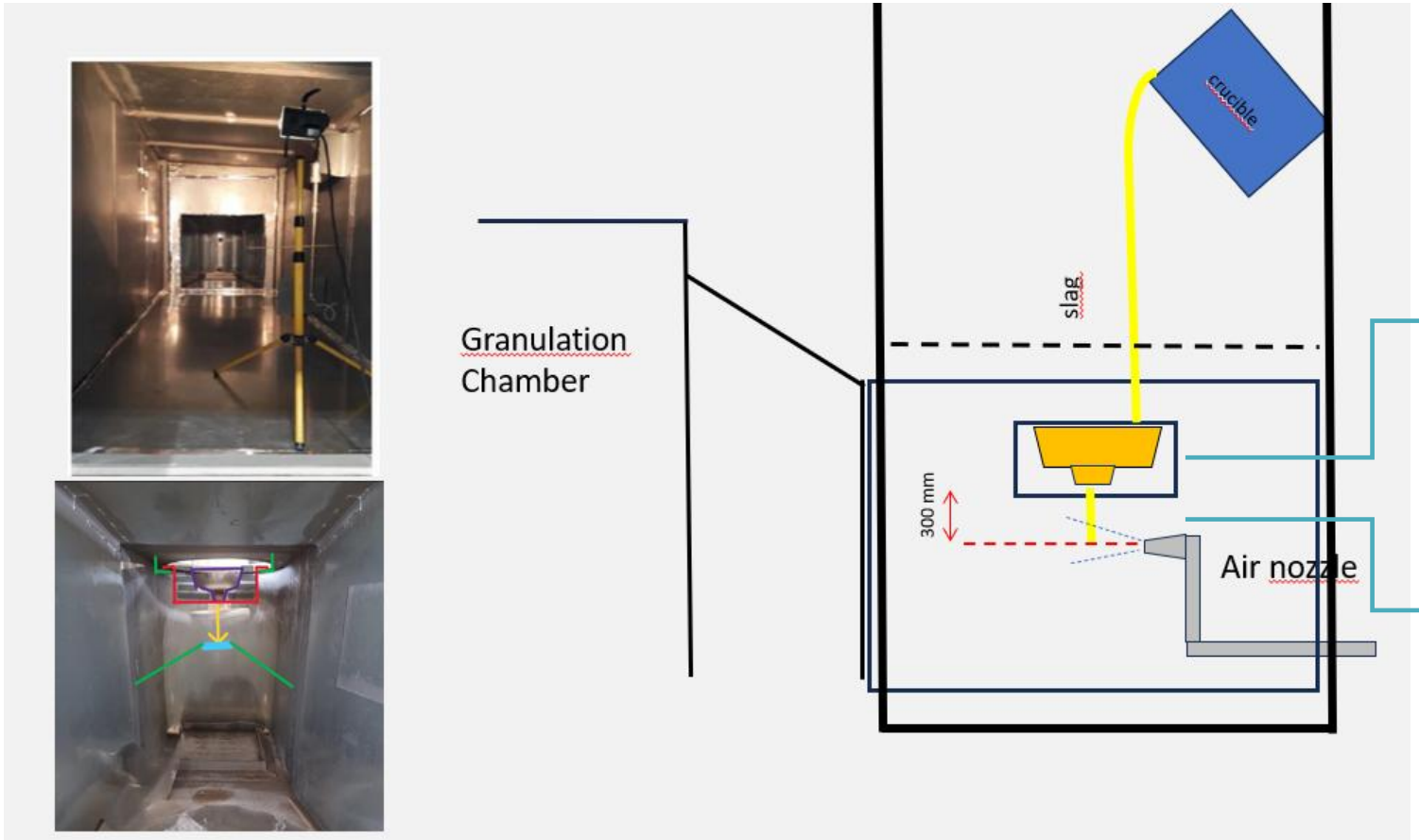




Average diameter		
CFD	1.98	mm

Modification of Rina-CSM Pilot Plant

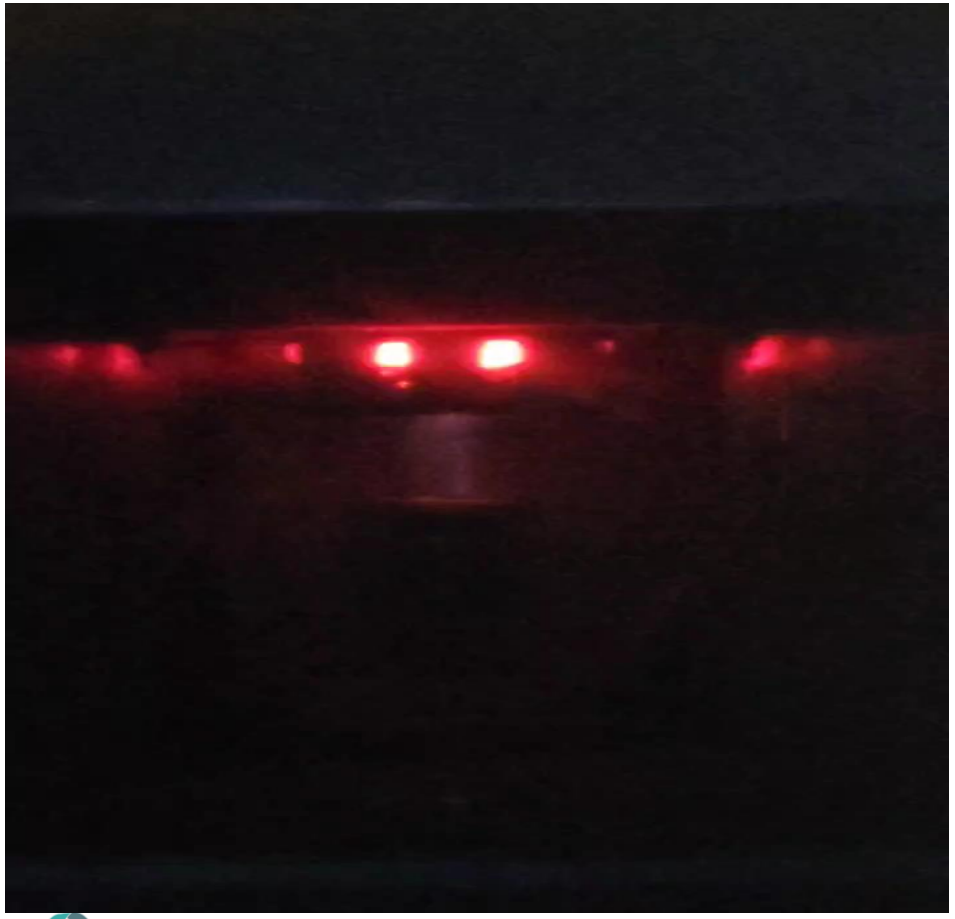
The pilot plant has been improved according to simulation carried out by Tenova



Continuous
slag flow

Granulation Test @ Rina-CSM Pilot Plant

Testing of dry slag granulation: 100% DRI

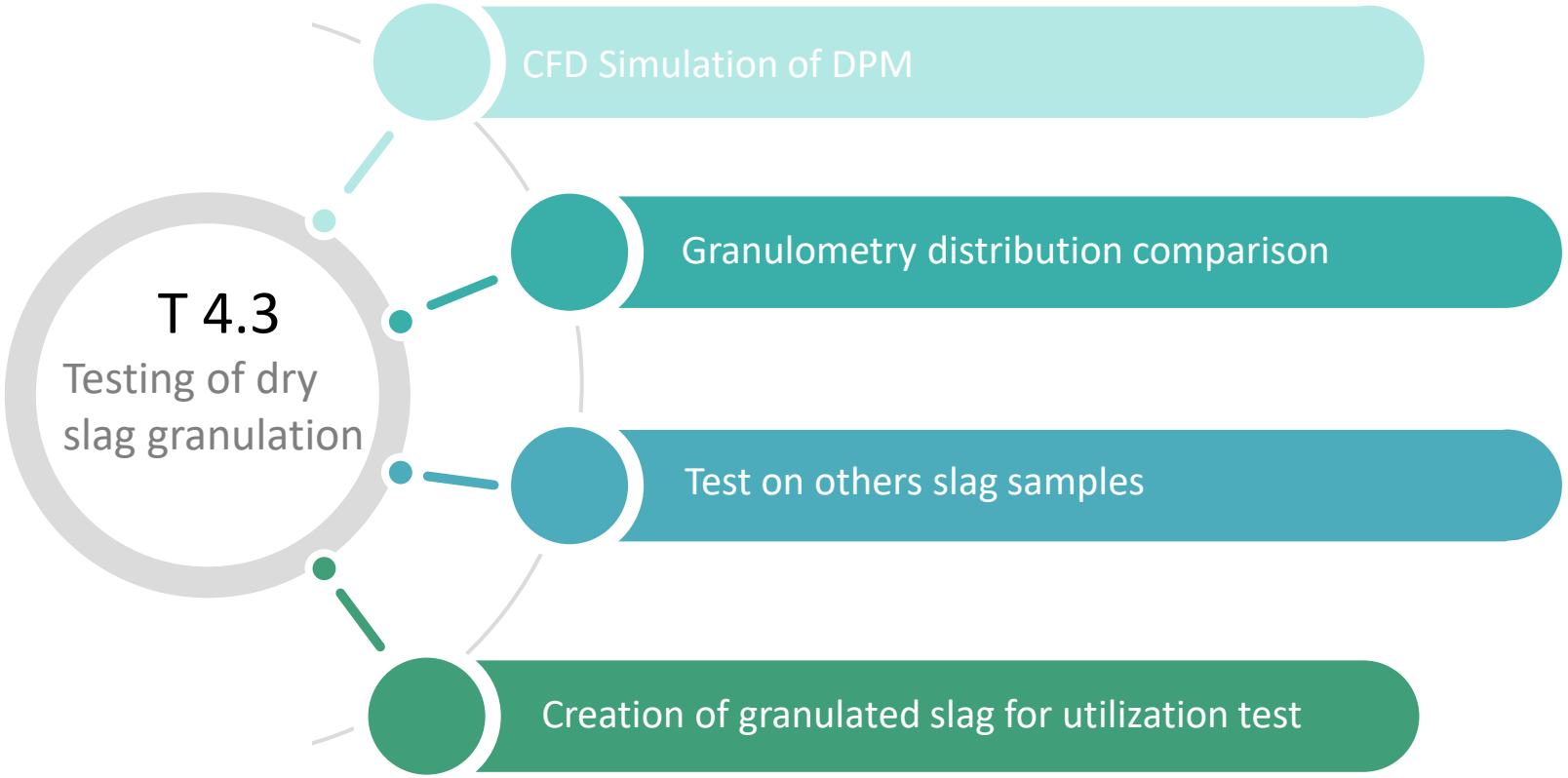


Input quantity:
15 Kg di Fe+ 5 Kg slag

Average diameter		
Exp	1.86	mm
CFD	1.98	mm

Task 4.3 -Testing of dry slag granulation

Next steps



InSGeP

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Marta Guzzon - Tenova

European Commission

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