



Replace **trial & error** with numerical simulation to save **time & money**







WHO ARE WE?

SCIENCES COMPUTERS CONSULTANTS edits and markets **numerical simulation software** dedicated to industrial processes.

In a context where raw materials and energies are becoming more and more expensive, reducing conventional methods «trials/errors» is a considerable argument.







Applications for packaging, compounding, pharmaceutical, aeronautic, automotive, nuclear, transportation, agro food



Optimizing Twin Screw Extrusion process with advanced simulation software





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An help decision making tool for TSE processes optimisation

- ♦ A 3D powerful software
- 100% dedicated to Twin Screw
- Compatible for any geometries
- Multi applications !











XimeX-TSE main focus





- Process higher effectiveness
- Easy control
 - User/super-user modes
 - Relevant languages
 - Adapted results
- Quantifying the mixing efficiency
 - Indeep analysis
 - Easy comparisons



The XimeX-TSE strategic position



The CFD software – Principles

- 3D Computational Fluids Dynamics
 - High calculation precision
 - Indeep physics analysis
 - Stokes-Navier Stokes
 - Transient model
 - Full parallel computation code
- Finite Elements Method (FEM)
 - Fast automatic meshing adaptation
 - Quick assembly of the twin screw
 - Dedicated approach for process engineer
 - Anisotropic mesh adaptation
 - Immerged mesh domain method
 - Suitable for any geometry







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- Immersion method
 - The CAD files
 - .stl
 - .step
 - ...



A screw generator can be used for self wiping éléments : no needs of CAD files anymore!







- Immersion method
 - Automatic meshing

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- Immersion method
 - High accuracy
 - Automatic adaptation





XimeX Techno – no user meshing



- Faster
- Done once time
- No remeshing at each step

Classic software : a few <u>days</u>







CFD Advantages

- Reproducing any kind of geometries
- Providing high results accuracy
- Tracking particles for quantifying the process efficiency









Quantifying the mixing efficiency



• Unique results for reading the mixer mixing capabilities

Analysis function	Distributive mixing	Dispersive mixing	Mixing time
RTD Average	Х		Х
RTD Variance	Х		
Cumulated strain	Х		
Z coordinates	Х		
Cumulated heating		Х	
Fibres breakage		Х	
Cumulated dissipated energy		Х	
SME		Х	
Erosion		Х	
Local elongation		Х	
Cumulated vorticity		Х	
Time effe	ect Energy	v effect	



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Adapted data set up for optimization targets





VTS

- XimeX Techno full parallel
- High scalability OpenMPI



Practical – Material management

[Manage materials] Tab

- One tab to add and modify materials
- Various parameters :
- Thermal characteristics
- Rheology laws (8 available !)
- Thermo dependency included
- Kinetics laws and dependance

🚱 SCCLa	ib by SCC ×
File	faterials Analysis ?
🕑 🛍	Manage materials →
- 🐨 SCO	Clab
Material name	
Material profile	XimeX-Polymer - v1.0
Data group	[1/4] Thermal characteristics
	×
Density (kg/m3)	
Heat capacity (J/(kg.K))	
Conductivity (W/(m.K))	
Material name	
Material profile	XimeX-Polymer - v 1.0 🔹
Data group	[2/4] Behaviour law_thermal-sensitivity
Behaviour law	Newton
	$\eta = \eta_{\text{Cross}}$
Viscosity (Pa.s)	Carreau - rasuda Papanastasiou Bingham
Thermal dependancy term	Herchel-Bulkley Carreau - Yasuda
	LUNDI

Practical – CAO Integration

Fast modeling of the geometry - [Resources] Tab

- Direct integration of the CAD files ٠ Format available : .STL
- Or Screw element generator

Extruder	Coperion - Coperion_133	3	 Element name 			
	O CAD File		Element type	Positive KB/TKD 👻		
	Self-wiping		Length (mm)	0.000		
	Positive KB/TKD—					
	Leakage (mm)	1,330	Disks count	4		
	Lobs #	•	Staggering angle (°)	60		
			Twist angle (°)	0.0	WILL BOOM	
				AT A BOARD	AND AND A	
		Apply	Cancel			
				ATTACK -	KAREARE	
				AAAAAA	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	
				AXXXXXXXXXXX	HE LEAST	L
					A A A A A A A A A A A A A A A A A A A	
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Practical – Process conditions

Only a few parameters for the process definition -[Simulation] – [Process] Tab

One tab to set all the process conditions parameters

- 1. Screw rotation speed
- 2. Material and additives selection
- 3. Flow rate + material feeding T°C

Easy control on a few set of parameters !

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		ing System					
Project: -							
Extruder	Coperion - Coperion_1	33	Geometry	Coperion_Recep	otionCase		
Simulation	name Coperion_133mm	1					
older	D:\SCC_Lab2.4-Test	SIMU_XIMEX-TSE\					
Execution	Remeshing Process	2 Physical models	2 Numerical models	Particles	Results Log		
(1)	Shafts rotation speed (rpm)		300,00				
	Simulated revolution (revolution)		1,00 ().2000 (s)			
	Angular rotation / computing step	C	1,00 ().0006 (s) :360 In	crements		
	Results storage frequency (3D) /	computed increments	1 ().0006 (s) : 360 re	sults		
	Feeding zone						
$\binom{2}{2}$	Product Properties Core						
G	Reception Case	•	A 4	dditive	% »	5	
	Modified:12/03/2024 lratte@ Law=Newton	pegase3		Ø % mass	© % volume		
\bigcirc		● Flow rate (kg/h)	Flow rate /kr	(h)	4 000 000		
S		O Pressure (bar)	now rate (Kg	···/	+ 000,000		
[Initial conditions						
	Product initial temperature (°C)		20				
	Exit zone						
		 Flow rate (kg/h) Pressure (bar) 	Pressure (ba	r)	0.0		
		Check Sav	re Generat	e			
		Con	erion - Coperion 133	Coperion	133mm	5	







- Material Flow computation
- Velocity, shear, pressure, temperature...
- Particles results for mixing efficiency quantification
 - Based on the CFD layer, particles are launched for flowing on the material path
 - Specific properties are then analysed
 - Elongation, erosion, self heating, local elongation, cumulated energies...

The CFD Results

Shear rate CFD result

- Local analysis focused
- High precision on distribution
- Increment 90
 - Average shear rate : 153,1 s⁻¹
 - Max shear rate : 1500 s⁻¹
- Increment 360
 - Average shear rate : 152,9 s⁻¹
 - Max shear rate : 1500 s⁻¹

CFD 1D – Sensors results - Shear rate

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CFD 1D global results

- A process overview
- Average results as a function of time

The Particles Results

Particles traking 3D – Cumulated strain

-

• Time 5s (Incr 9 000)

Average heat : 139 °C

Max heat : 300 °C

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XimeX-TSE Packages

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XimeX-TSE Conclusion

- Highlighting process/material behaviour
- Quantifying the mixing effiency
- High precision on 3D and 1D results
- Advanced numerical technology
- Tool dedicated for process analysis by process engineer
- Easy interface control

It's always worth playing with numerical simulation To support the process optimization

- For your process optimizations support, SC-Consultants does propose
 - Studies/consulting
 - Training
 - License (temporary/permanent)

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- https://support.scconsultants.com

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- Classic licensing models
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