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HERAKLION 2019

THE USE OF FLASH CALCINED DREDGING SEDIMENTS IN CEMENTITIOUS MATRIX

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26 – 29 June

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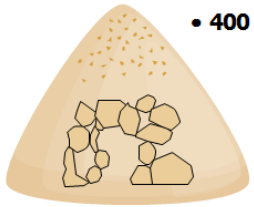
Solid wastes: 2 billons t/yean [1]

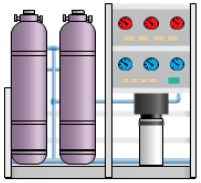
Cement industry: 2680 Mt de CO2 30→50 €/t €/t

1 Aggregates



- 400 Millions of tons/year (France)

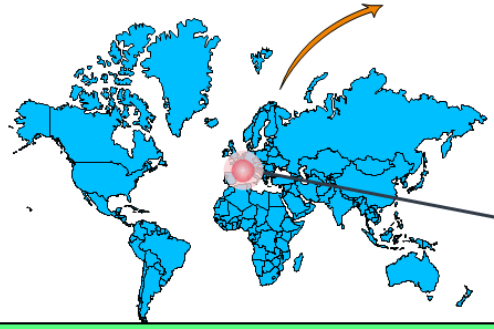
2 Cement



1T of Clinker
⇓
1T of CO_2

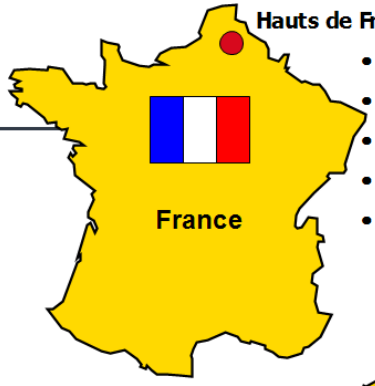
- Energy ⇒ 8000 MJ / 1 T
- Cost ⇒ 150€ / 1 T Clinker

SEDIMENTS



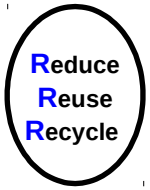
Country	Sediment (Mm^3)		Total
	Marine	Continental	
France	50	6	56
Occidental Europe	118.2	24.8	142.2
USA	300	57	357
China	287	66	343

3 Dredging



Hauts de France

- 6500 Km of coasts
- 6 autonomous ports
- 69 commercial ports
- 20 departmental ports
- Etc.



Satisfying the **3R law**

4 Ports

[1] World Bank, (2012).

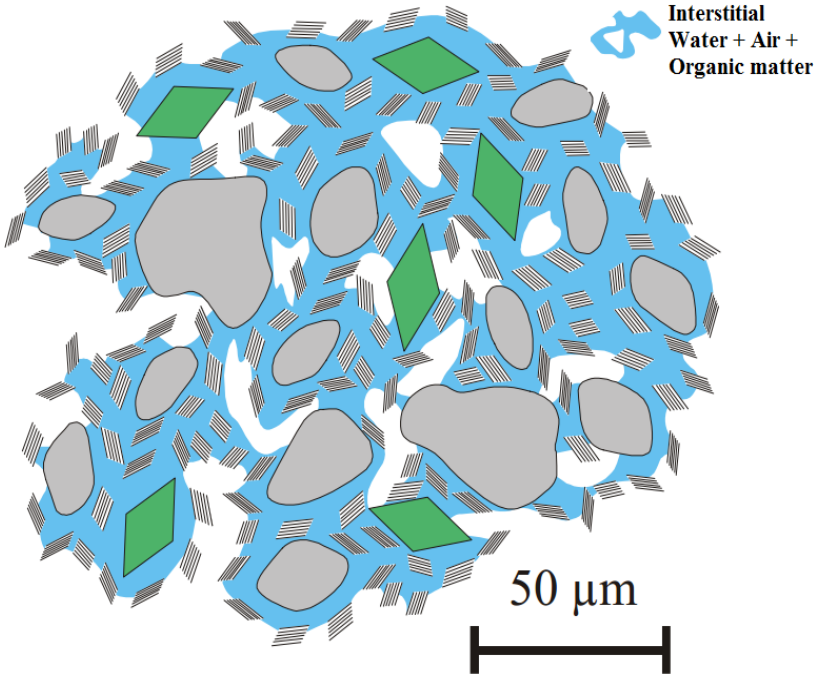
Definition - Composition

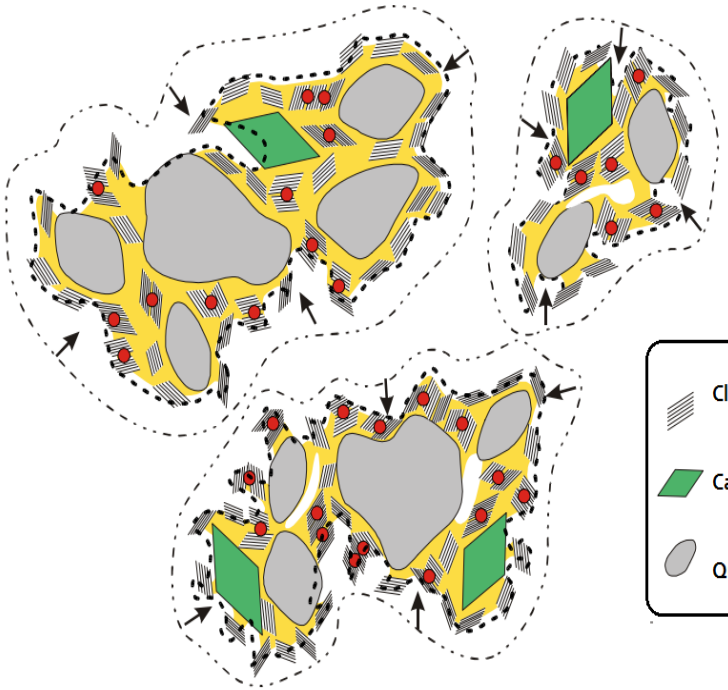
- **Main mineral constituents**

- Quartz,
- Clays,
- Limestone, etc.

- **Other constituents**

- Organic matter
- Contaminants: PAH, PCB, TBT, Heavy metals (Fe, Pb, Cr, etc).





(Cabane, 2004)

Fig : Approached structure and behavior of sediment materials when blended

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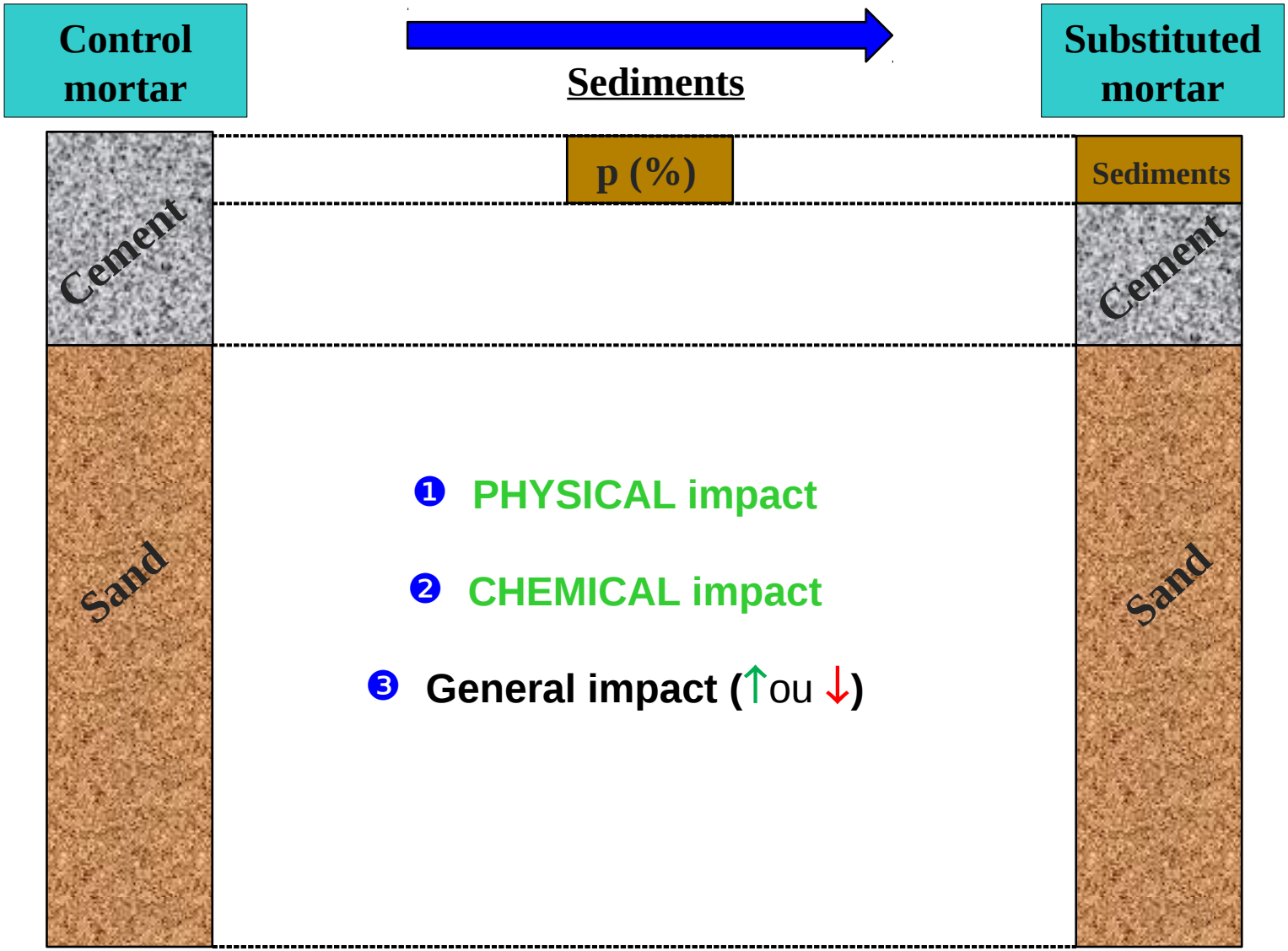
Objectives



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Materials

- ***Cement***
  - *CEMI 52.5N : Cement :*
    - $C_3S \cong 70\%$
    - $C_2S \cong 10\%$
- ***Sand***
  - Normalized Sand ISO, (*ISO*679 : 2009) : Quartz
- ***Sediments***
  - *Sediments treated by flash calcination process*
- ***Other admixtures***
  - *Metakaolin, limestone filler,...*
  - *For comparison purposes*
- ***Water***
  - *Optimization of water demand*

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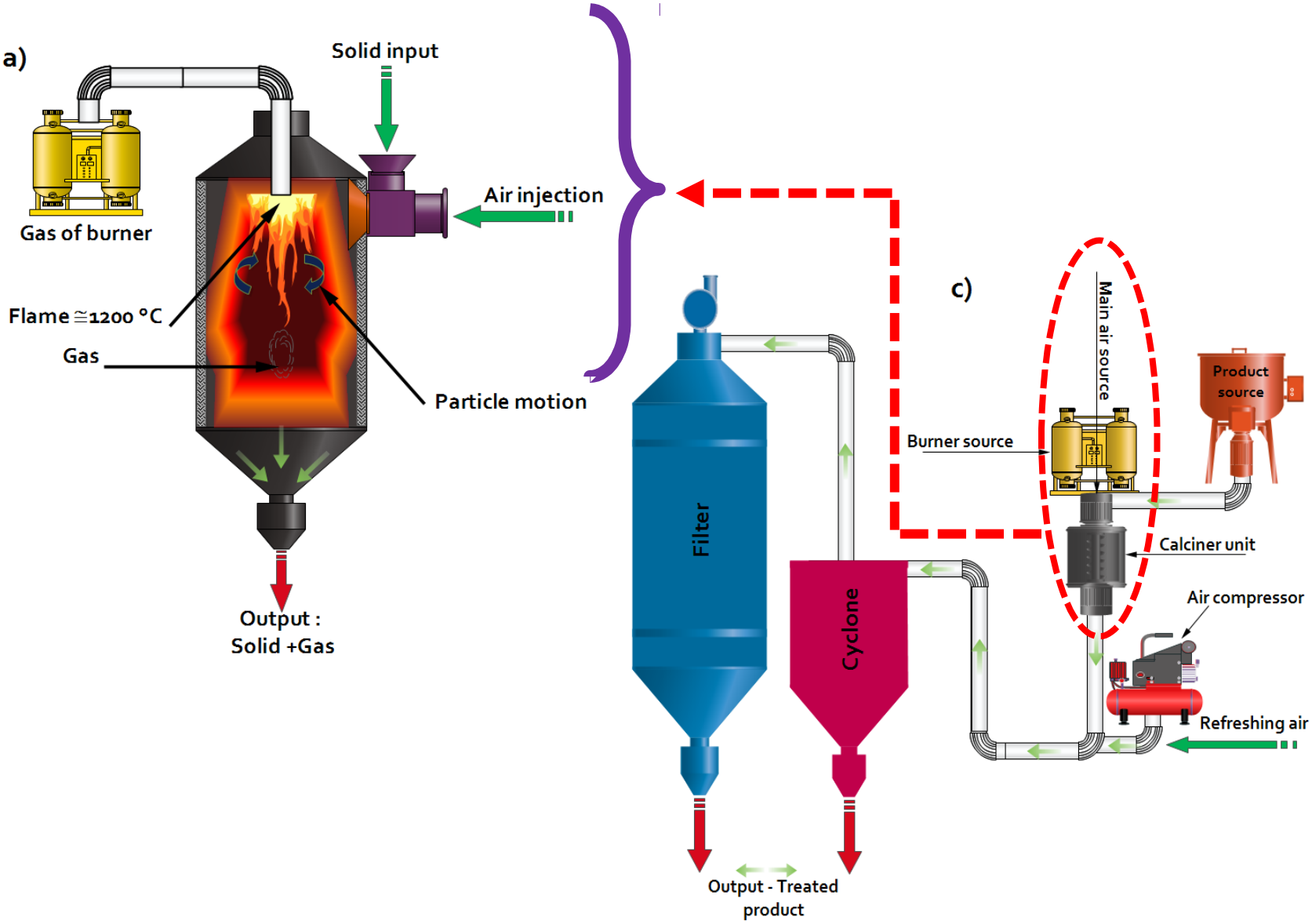
Falsh calcination principle



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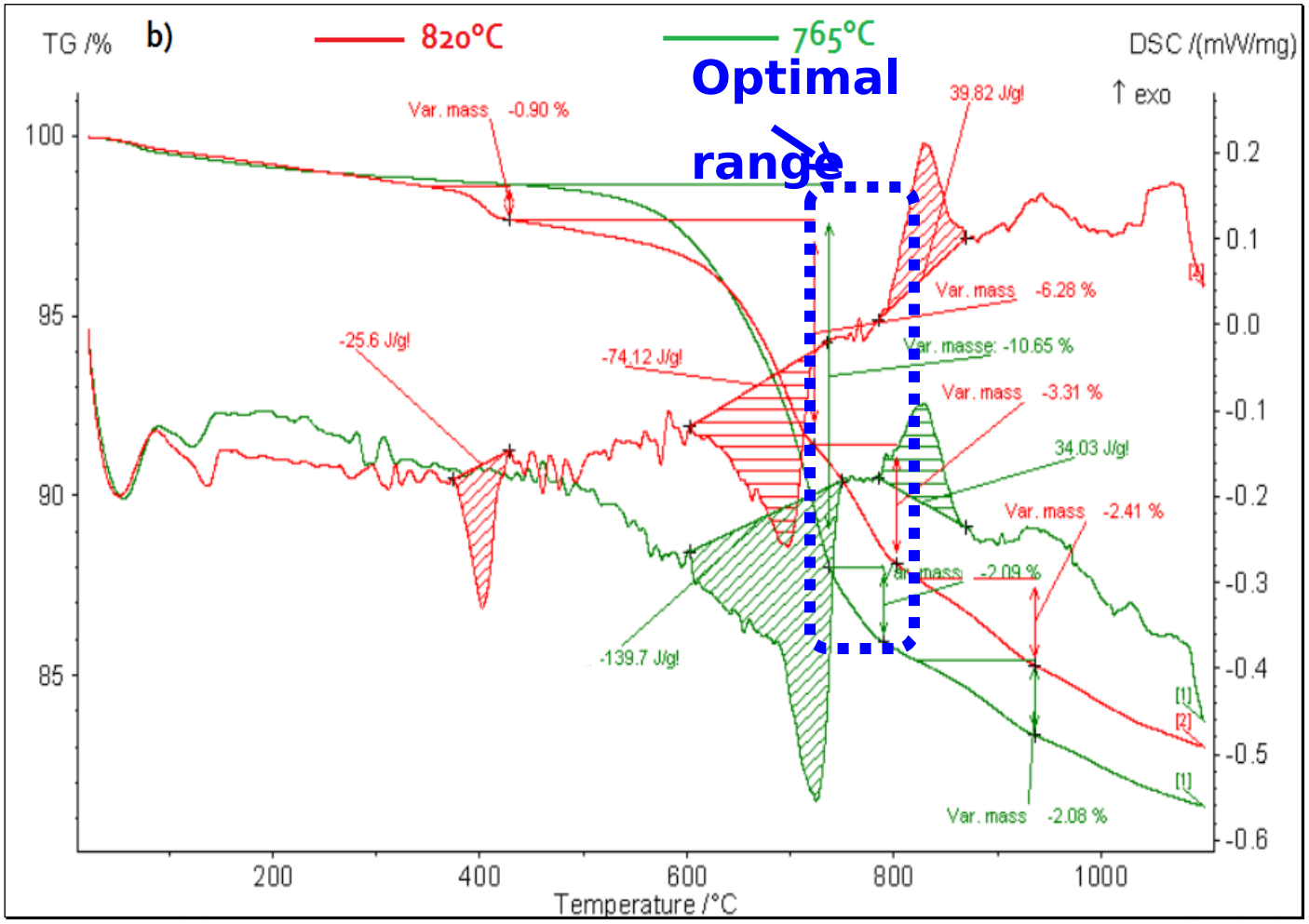
Falsh calcination optimisation



❶ **Minimization** mass loss between **[400°C – 800°C]** **« Activation degree»**

❷ **Equalization Amorphization** and **Crystallization** areas

Falsh calcination optimisation

Materials	Cement CEM I 52.5 N	Raw sed 120µm (RS)	Calcined sediment (STDC)	Flash calcined sediment (STFC)	Matakaolin (MK80)	limestone fillers (LF80)	Natural Sand (NS)
Density (g/cm3)	3,15	2.48	2,94	2.65	2.74	2.70	2.65
BET area(cm^2/g)	9194	86207	20641	59930	94600	9744	9507
TOC (%)	---	6.1	0.27	0.99	---	---	---
Mass loss (%)	1.9	9.92	0.47	1.70	---	---	---

- Major physical modifications (organic matter elimination, etc.)
- Calcination modifies properties (by **densification**, **sintering**, etc.).

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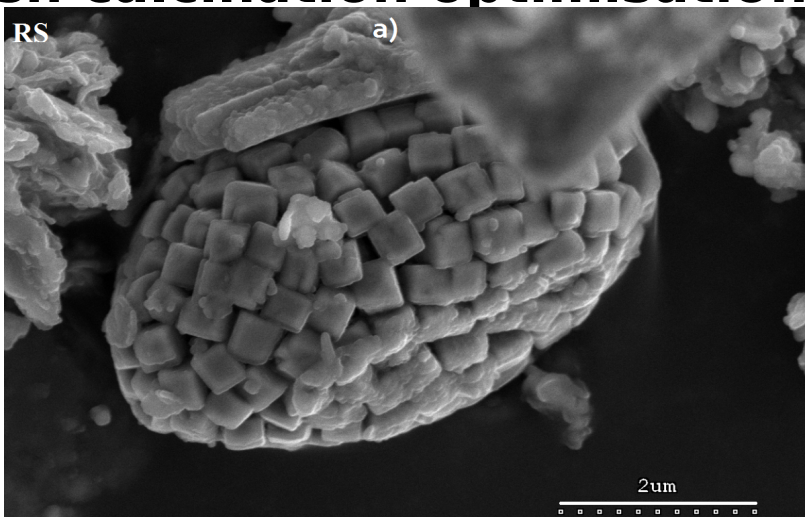
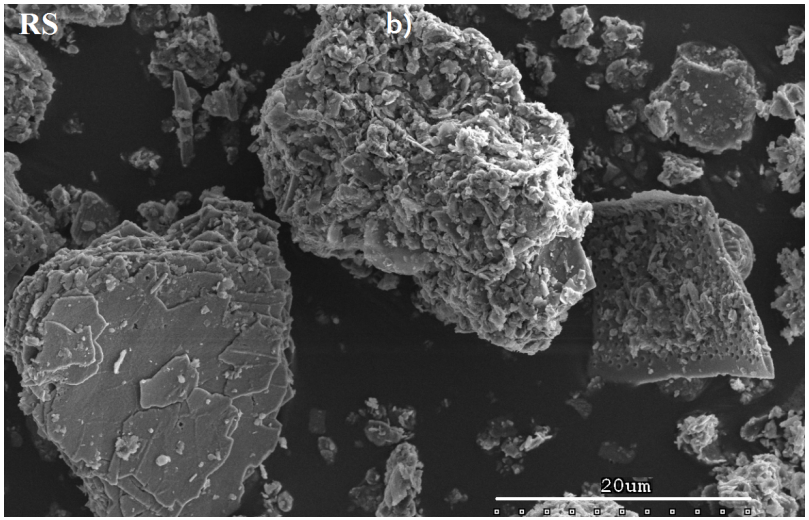
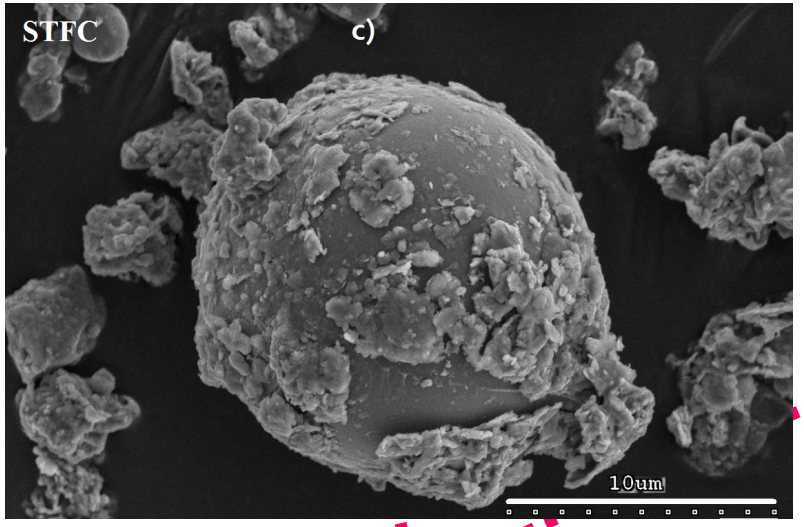
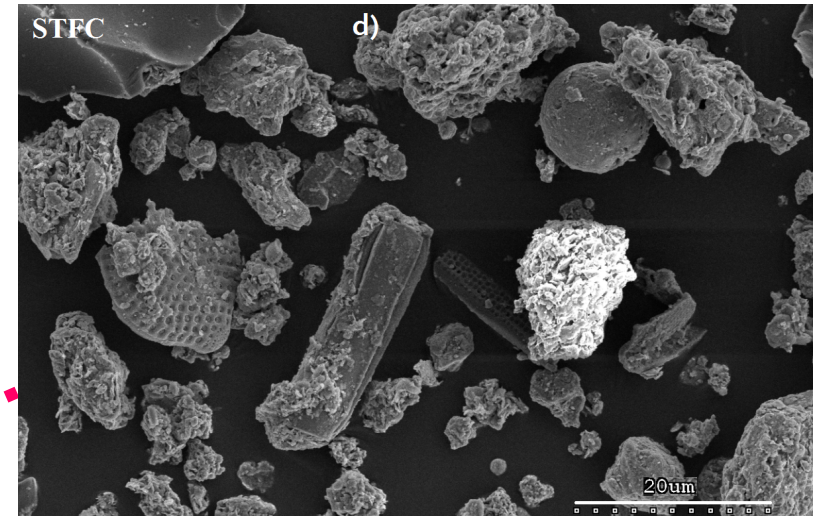
Falsh calcination optimisation









- Particle rounding process
- Composed by **submicron particles** and **gases**

9

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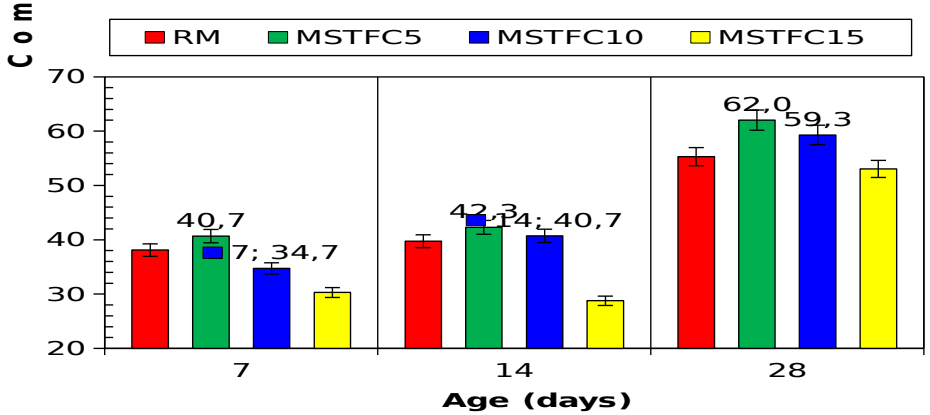
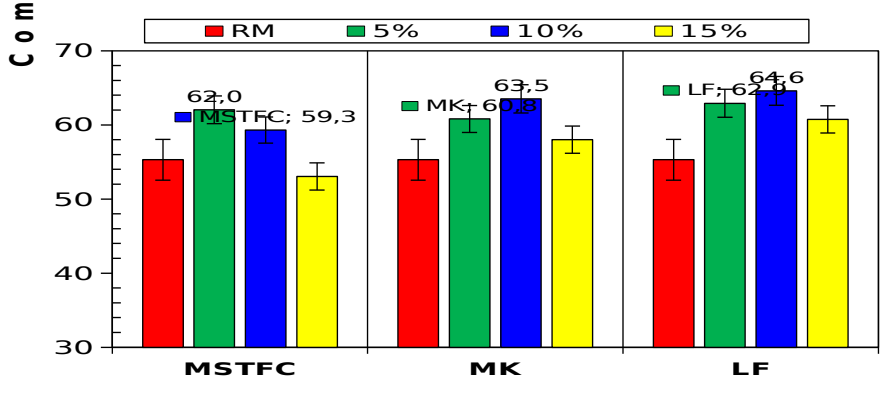
Compressive strength





MSTFC = flash calcined sediment based mortars
RM = control mortar without sediments

- The MSTFC5 and MSTFC10 present **better performances** than RM
- Potentially due to a **pozzolanic effect**
- Possible **dropdown of matrix porosity**

REUSD POSSIBILITY

Projects SETARMS, PRISMA, ECOSED, GPMD, SEDIMATERIAUX

Road

Dyke

self-compacting concrete

Urban furniture

Reservoir concrete pavement

Aggregates

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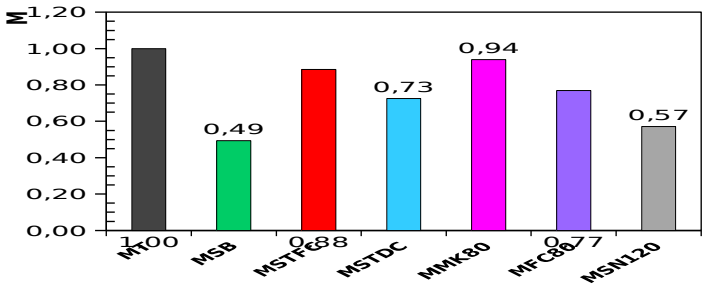
Activity index

Tab : Activity index of mortars

	Mechanical resistance (MPa)		Activity at 28 jours				
	7 days	28 days	28/7 days (%)	Bolome	De Larrard	Error	Error
RM	38,09	55,3	25	1	1	1,068	6,34%
RM	38,09	55,3	25	0,80	1	1,068	14,16%
MSB	35,65	45,15	25	1	**0,494**	0,578	6,54%
				0,80			14,56
MSTFC	31,51	52,93	25	0,95	**0,885**	**0,949**	6,72%
				7			
MSTDC	40,21	49,70	25	0,89	**0,725**	0,791	8,37%
				8			
MMK80	41,61	54,05	25	0,97	**0,939**	1,004	6,47%
				7			
MMK80	41,61	54,05	25	0,91	**0,939**	1,004	6,47%
MFC80	42,31	50,57	25	0,91	**0,769**	0,833	7,76%
				4			
MSN120	38,66	46,65	25	0,84	**0,571**	0,648	11,81%
				3			
0	38,66	46,65	25	0,83	**0,571**	0,648	11,81%

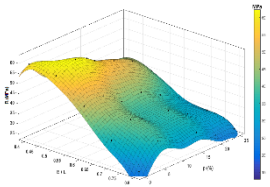


$$\chi_A = 1 + \frac{1}{\left(\frac{p}{2,3}\right)^{3}}$$

De Larrard (2000)

$$\chi_A = -3*\ln(0,91 - \frac{2,2}{\left(i(t)*0,0522 + d(t)*d(t)\right)^{-0,351} - 1})$$

- **high pozzolanic potential** of flash calcined material (
- **high pozzolanic potential** of flash calcined material ($\chi_A = 0,88$)



FOUNDING MEMBERS OF THE CHAIR: CIRCULAR ECONOMY OF SEDIMENTS ECOSED DIGITAL 4.0

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Pour plus d'infos: Publications 2017-2018
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J Mater Cycles Waste Manag
DOI 10.1007/s10163-017-0626-0

ORIGINAL ARTICLE

Formulation of mortars based on thermally treated sediments

Mahfoud Benzerzour[1] · Walid Maherzi[1] · Mouhamadou. A. A. Amar[1] · Nor-Edine Abriak[1] · Denis Damidot[1]

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ORIGINAL ARTICLE

Environmental impact and mechanical behavior study of experimental road made with river sediments: recycling of river sediments in road construction

Abdelhafid Kasmi[1] · Nor-Edine Abriak[1] · Mahfoud Benzerzour[1] · Hassane Azrar[1]

Waste Biomass Valor
DOI 10.1007/s12649-016-9587-0

ORIGINAL PAPER

Effect of Dewatering by the Addition of Flocculation Aid on Treated River Sediments for Valorization in Road Construction

Abdelhafid Kasmi[1] · Nor-Edine Abriak[1] · Mahfoud Benzerzour[1] · Hassane Azrar[1]

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New experimental approach of the reuse of dredged sediments in a cement matrix by physical and heat treatment

Mahfoud Benzerzour[a], Mouhamadou Amar[a,b,*], Nor-Edine Abriak[a]

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W. Sekkal[a], A. Zaoui[a,*], M. Benzerzour[b], N. Abriak[b]

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A bibliography on the analytical model of the mechanical behaviour in uniaxial tension of fibre concrete: Application to concrete reinforced with fibres and powders from recycling of thermoset composite materials

Mahfoud Benzerzour[a], Nassim Sebaibi[b,*], Walid Maherzi[a], Nor Edine Abriak[a], Yahya Sebaibi[c]

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Study of the pozzolanic activity of a dredged sediment from Dunkirk harbour

Mouhamadou Amar[a,b,*], Mahfoud Benzerzour[a], Nor-Edine Abriak[a], Yannick Mamindy-Pajany[a]

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Towards the establishment of formulation laws for sediment-based mortars

Mouhamadou Amar[a,b,*], Mahfoud Benzerzour[a], Nor-Edine Abriak[a]

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A laboratory-scale experimental investigation on the reuse of a modified red mud in ceramic materials production

Cyril Scribot, Walid Maherzi[a], Mahfoud Benzerzour, Yannick Mamindy-Pajany, Nor-Edine Abriak

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Review

Mechanical behavior of municipal solid waste incinerator bottom ash: Results from triaxial tests

Ngoc Hung Le[a,b,c,*], Nor Edine Abriak[b,c], Christophe Binetruy[d], Mahfoud Benzerzour[b,c], Sy-Tuan Nguyen[e]

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Case study

Durability of a cementitious matrix based on treated sediments

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Environmental Technology

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Beneficial reuse of Brest-Harbor (France)-dredged sediment as alternative material in road building: laboratory investigations

Walid Maherzi, Mahfoud Benzerzour, Yannick Mamindy-Pajany, Eleanor van Veen, Mohamed Boutouil & Nor Edine Abriak

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