SeRaMCo - Recycling Process

Belgian Concrete Day

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Summary of the presentation

- Influence of the washing process on aggregates quality
  - Grain size distribution
  - Fine content
  - Unwanted elements content
  - Particle density
  - Water absorption
  - Abrasion resistance
- Influence of the crushing method on aggregates quality
  - Grain size distribution
  - Morphology of the aggregates
  - Cement paste content
  - Water absorption
  - Energy consumption

Effect of washing on aggregates quality

Expectations of washing aggregates:

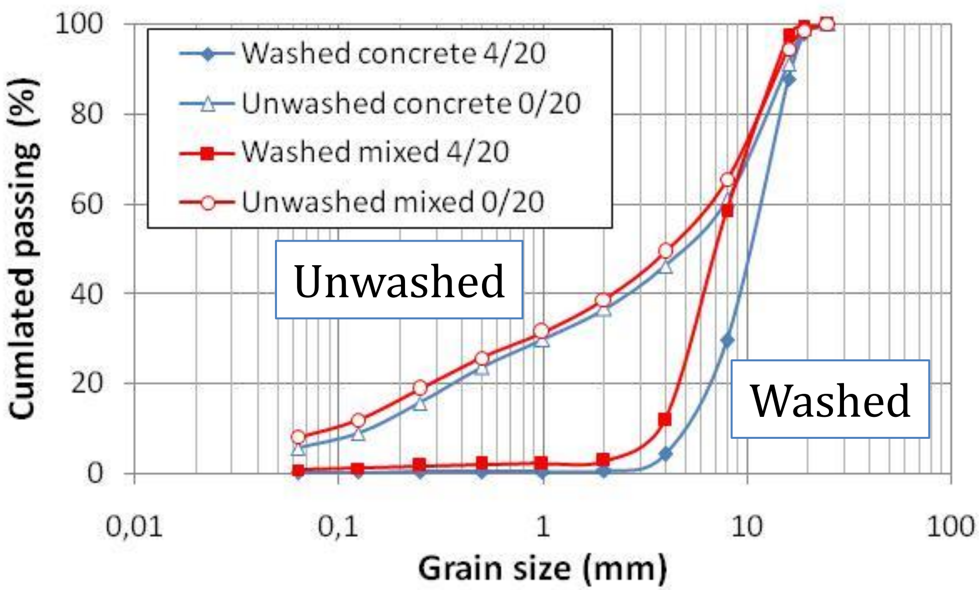
- Constrain grain size distribution
- Decrease fine content
- Decrease the quantity of unwished components (floating, clay, plaster...)
- Increase resistance to fragmentation

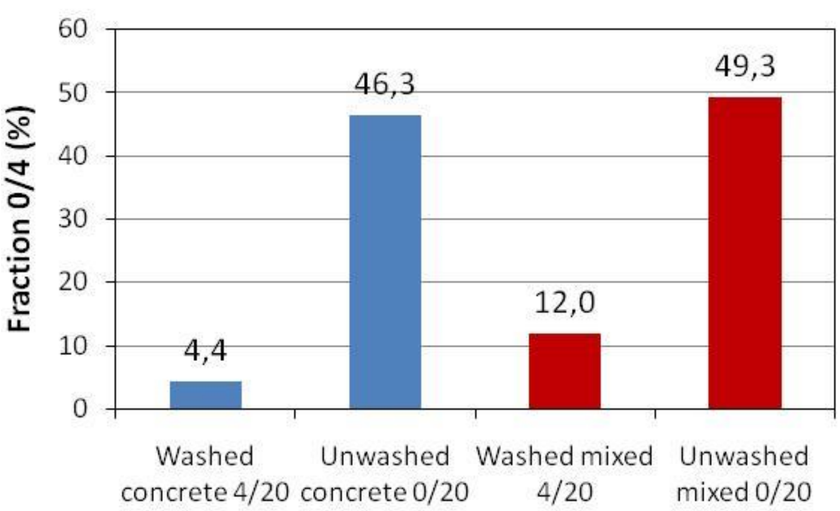
Methodology

Unwashed		Washed
Concrete aggregate 0/20	⟷	Concrete aggregate 4/20
Mixed aggregate 0/20	⟷	Mixed aggregate 4/20

Grain size distribution - aggregates

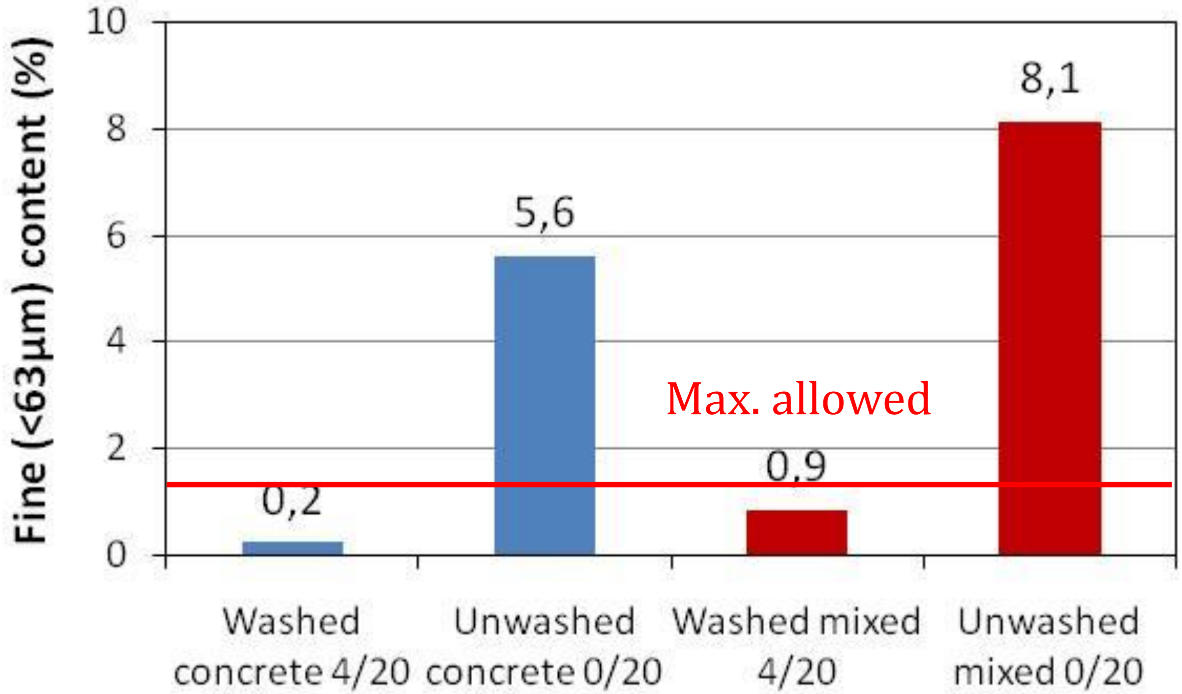
- 0/4 fraction comprises nearly 50% of the unwashed aggregates composition
- 0/4 fraction a bit higher in mixed aggregates
- Washing significantly reduces the sand fraction of the aggregates





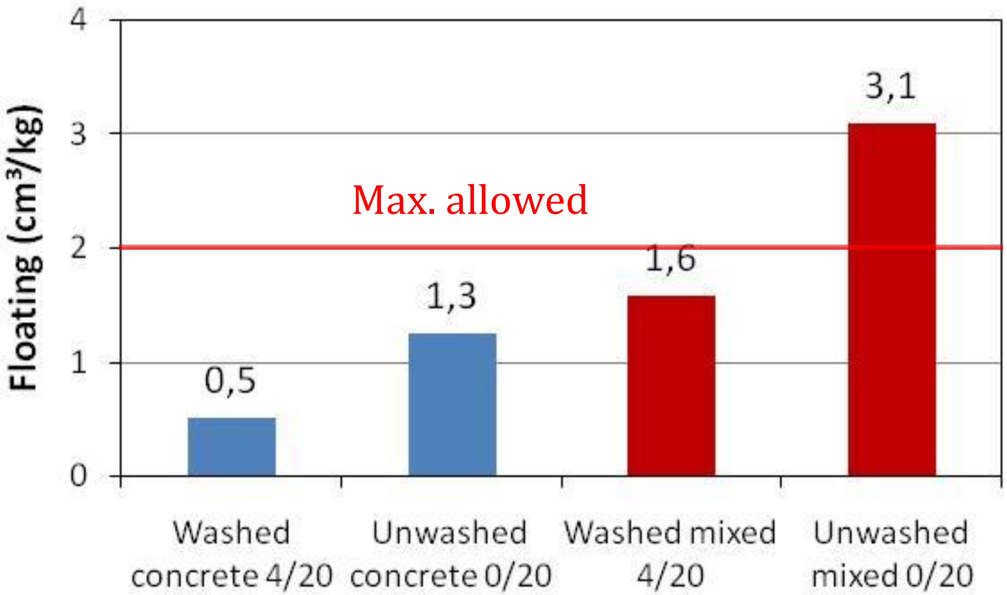
Grain size distribution - aggregates

- Fine content (< 63µm) higher in mixed aggregates and significantly reduced by washing
- Fine fraction higher in mixed aggregates
- Washed aggregates respect regulations in all considered countries



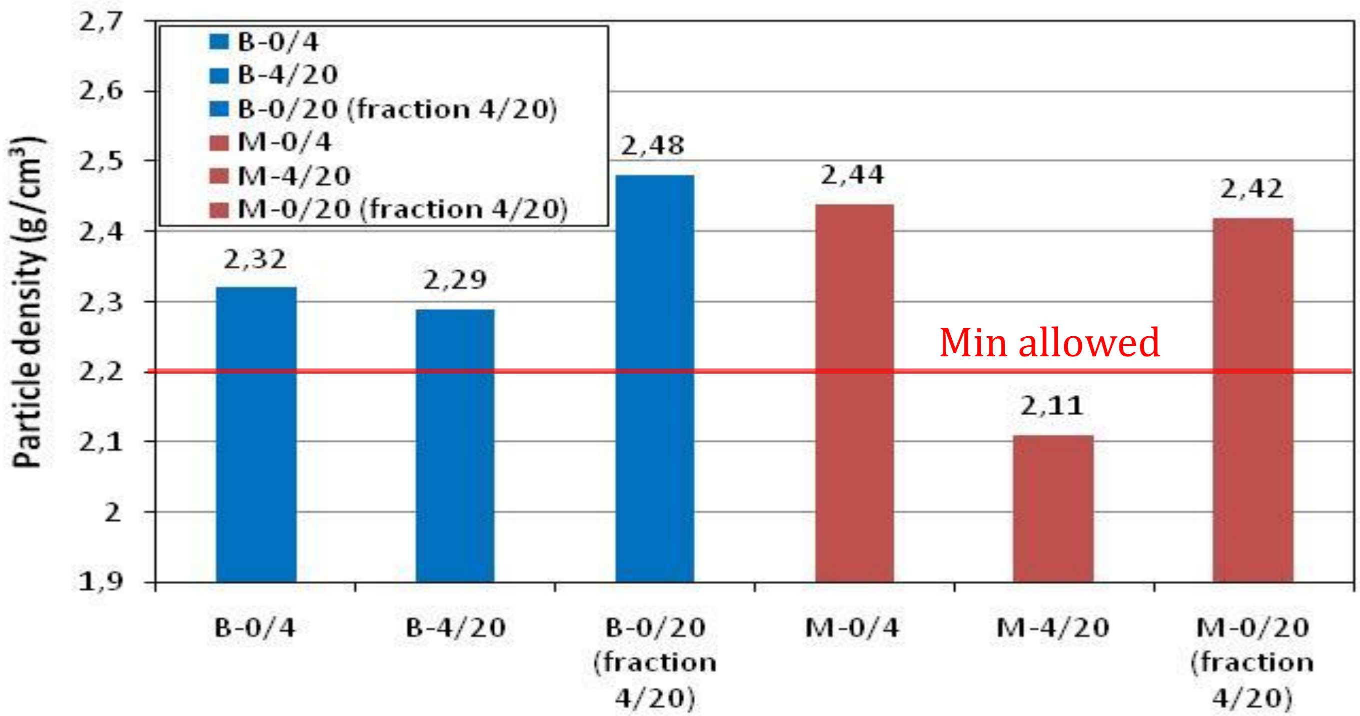
Floating elements

- Floating elements reduced by 50% after washing and reach suitable values for standards (max. 2 cm^3/kg)
- Washing required for mixed aggregates



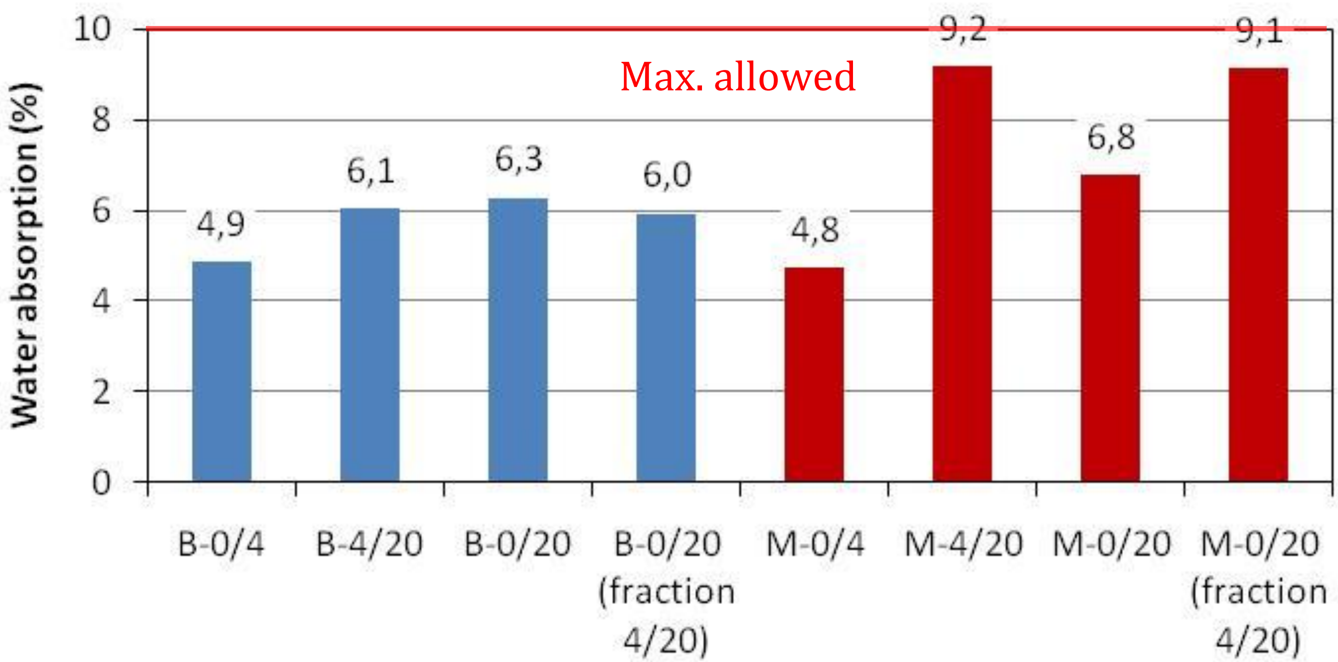
Particle density

- Density higher for recycled concrete aggregate than mixed aggregate
- Washing required for mixed aggregates



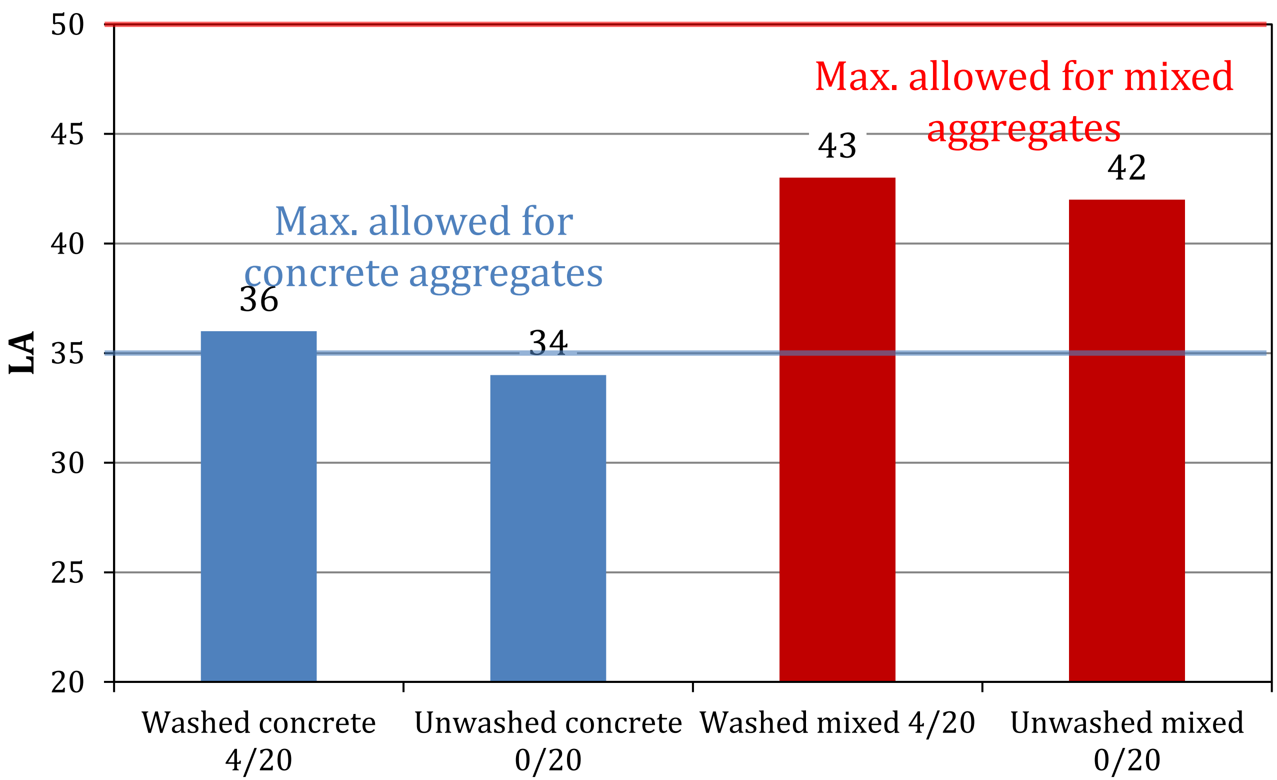
Water absorption

- Water absorption is higher for mixed aggregates
- Both washed and unwashed aggregated respect the requirements



Resistance to fragmentation

- Concrete recycled aggregates have better resistance to fragmentation
- No effect of washing



Aggregates washing conclusion

Expectations of washing aggregates:

- Constrain grain size distribution
- Decrease fine content
- Decrease the quantity of unwished components (floating, clay, plaster...)
- Increase resistance to fragmentation

Summary of the presentation

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Influence of the crushing method

Methodology

Production of 0/25

Impact crusher

Set at 6,5 kW (40% of maximum power)

Jaw crusher

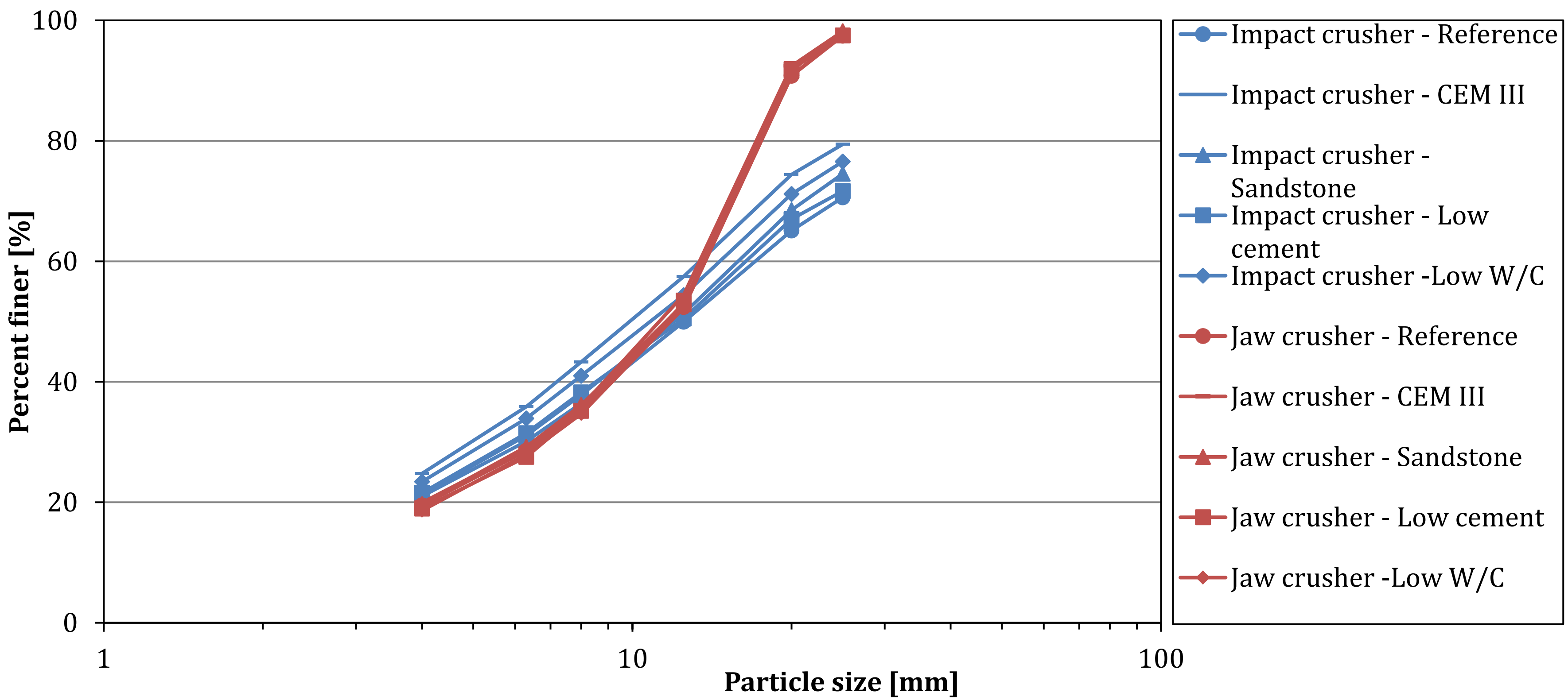
Jaw crusher set at a 22 mm opening

Influence of the crushing method

	1.0	1.1	1.2	2	3
Name	Reference	CEMIII	Sandstone	Low Cement	Low W/C
Aggregates type	Limestone	Limestone	**Sandstone**	Limestone	Limestone
Cement type	CEMI 52.5	**CEMIII 52.5**	CEMI 52.5	CEMI 52.5	CEMI 52.5
Cement quantity (kg/m^3)	400	400	400	**320**	452
Cement paste volume (dm^3/m^3)	351	358	351	**282**	351
W/C	0.56	0.56	0.56	0.56	**0.46**

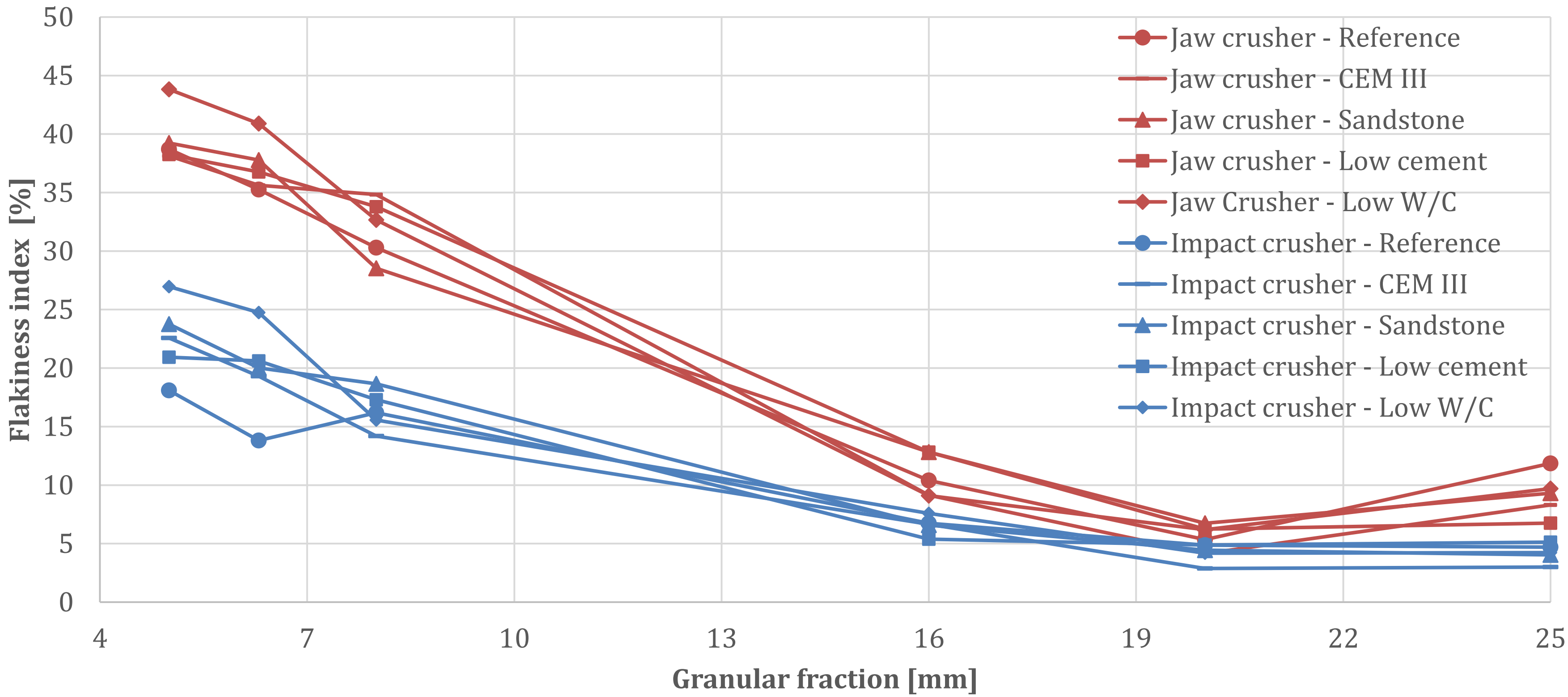
Grain size distribution

- The jaw crusher produces aggregates with a more constrained grain size range (for all the tested composition)



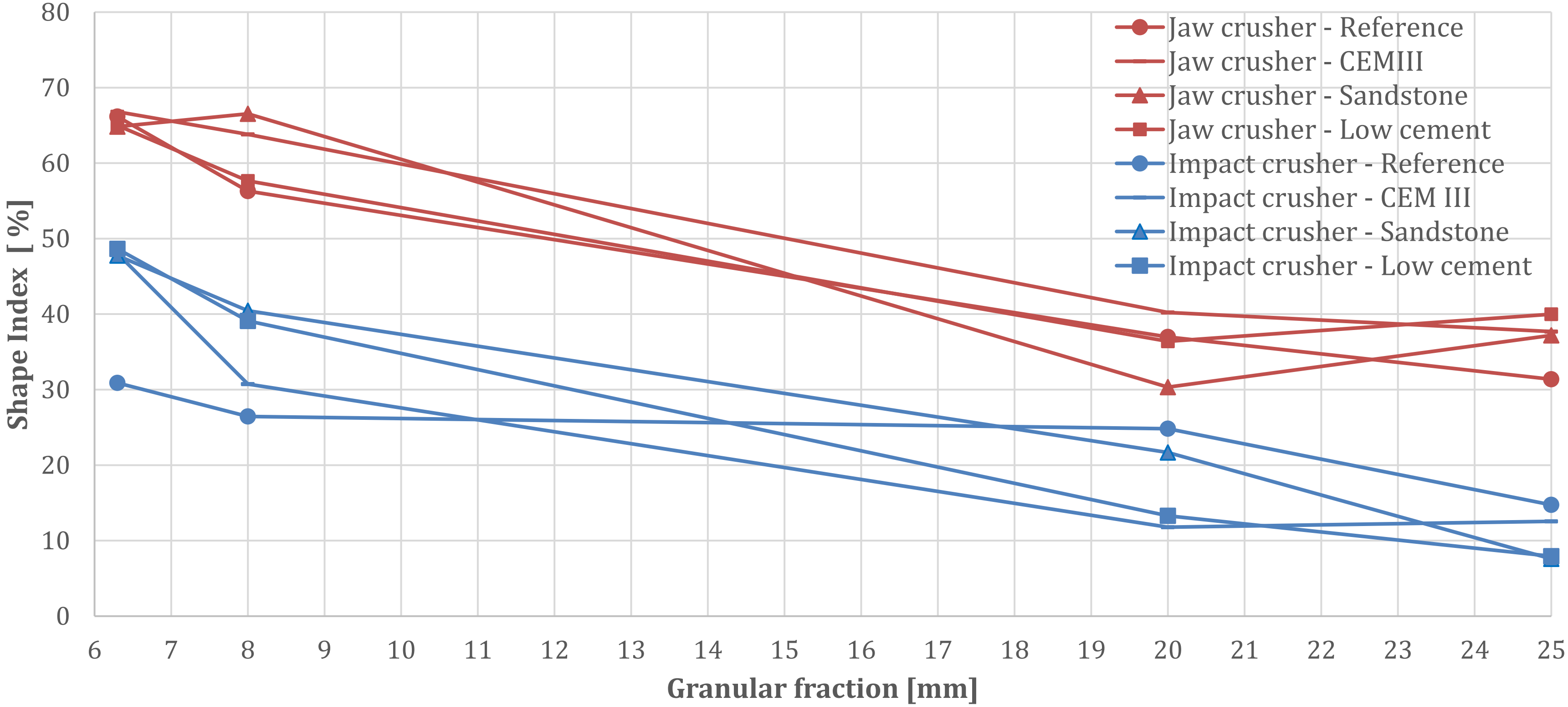
Flakiness index

- The flakiness index decreases with increasing granular fraction and the jaw crusher produces flakier aggregates
- No influence of the concrete composition



Shape index

- The shape index decreases with increasing granular fraction and the jaw crusher produces more elongated aggregates
- No influence of the concrete composition



Cement paste content

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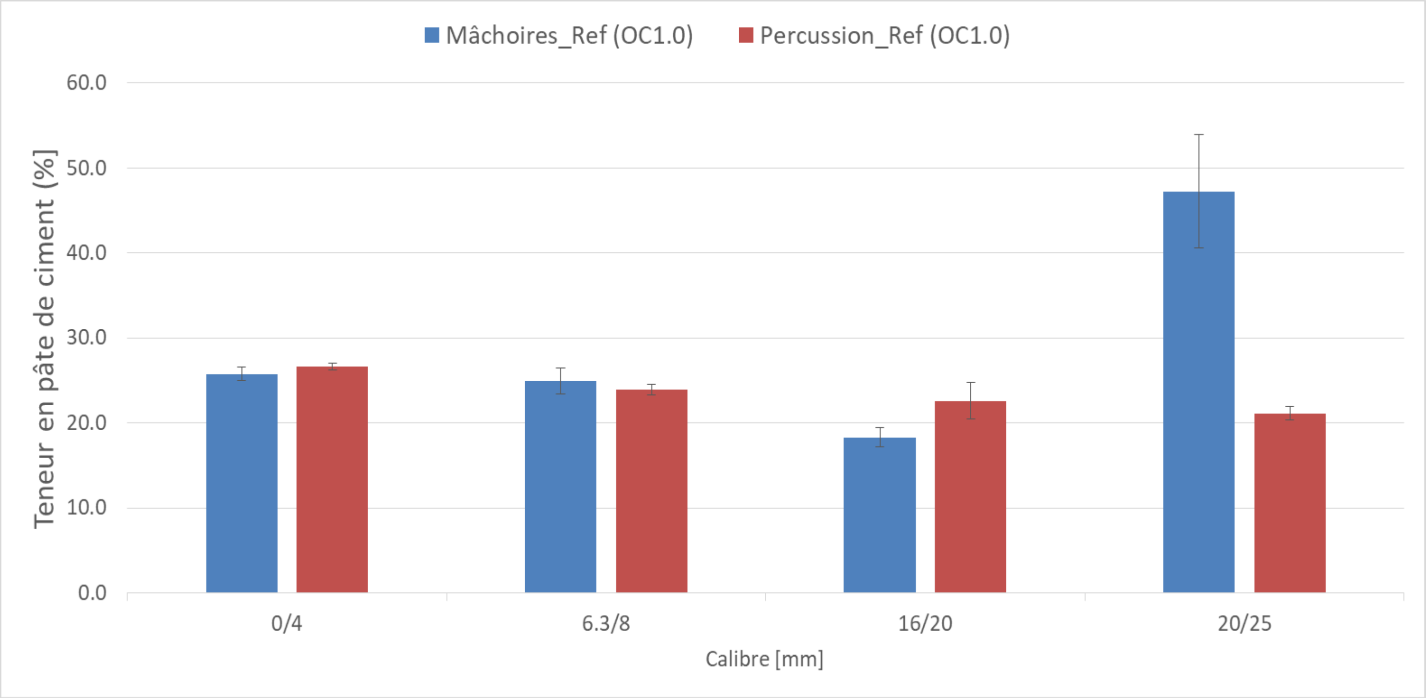
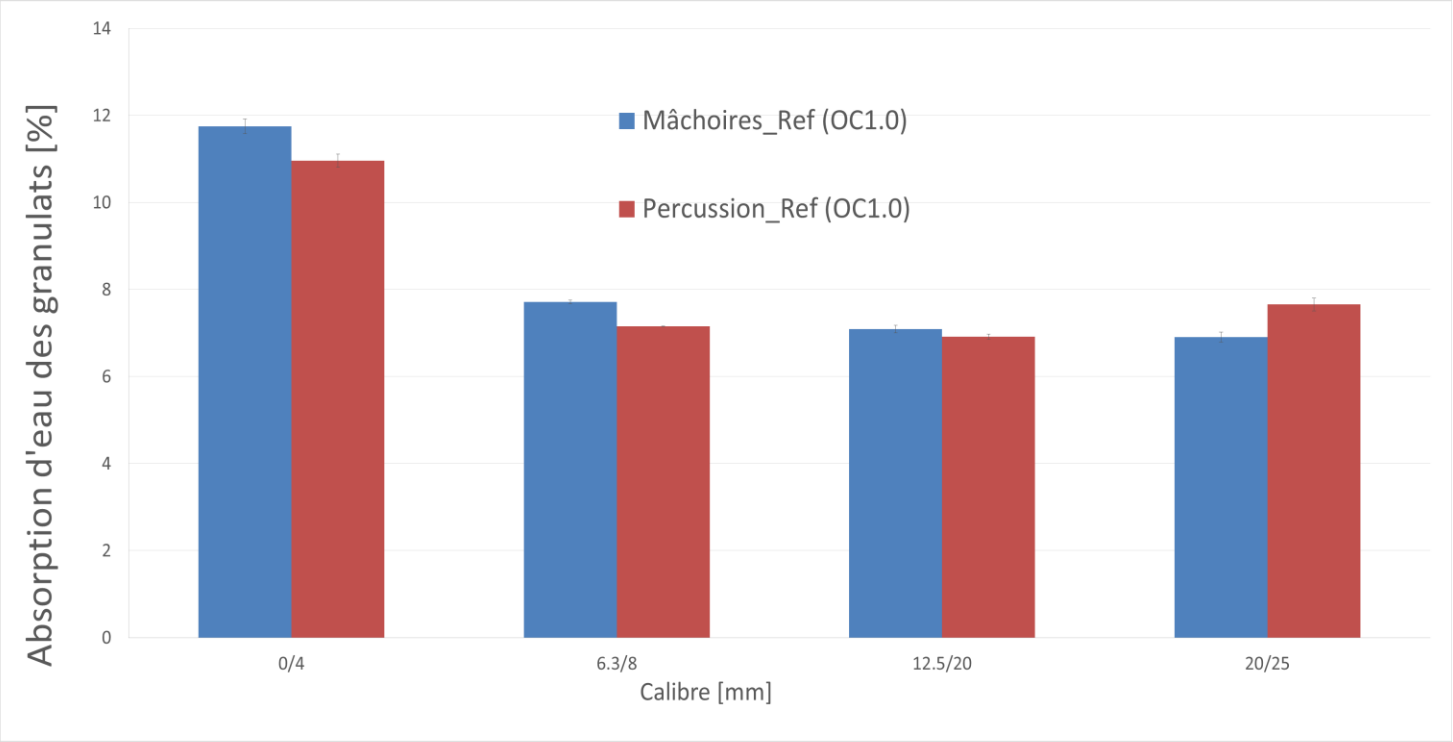


- Decrease in cement paste content with increasing granular fraction
- Exception : fraction 20/25 with the jaw crusher (abnormal results)
- No influence of the crushing method

Water absorption



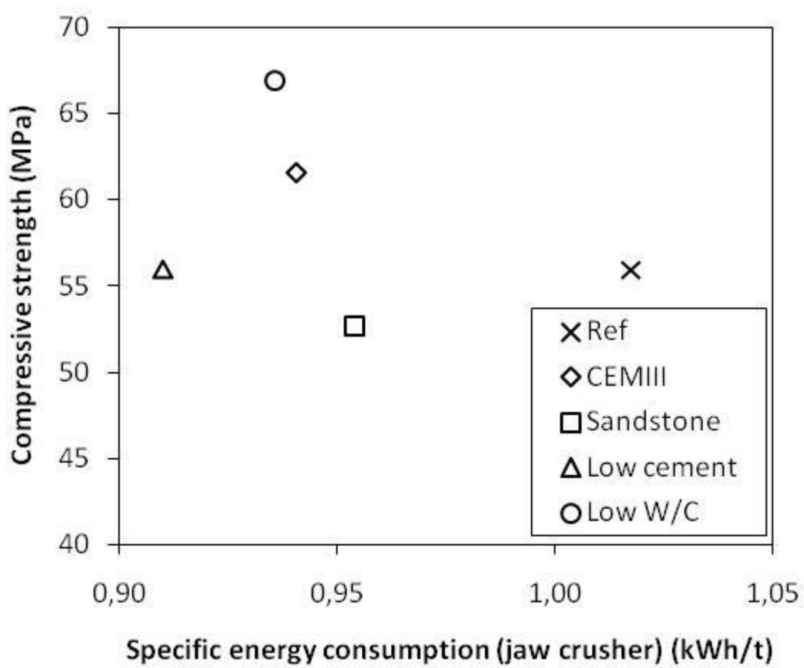
- No significant influence of the crushing method on the water absorption of the recycled aggregates (for all tested composition)

Crushing energy consumption analysis

	Jaw crusher	Impact crusher
(a) Running power (kW)	1,8-2,0	6,5-6,6
(b) Mean net power (kW)	1,9-2,1	0,5-0,8
(c) Mean crushing duration (s)	200	252
(d) Crushed mass of material per hour (t/h)	2,0-2,3	1,6-1,7
(e) Net specific energy consumption (kWh/t) **(b/d)**	0,9-1,0	0,30-0,50
(f) Total specific energy consumption (kWh/t) **((a+b)/d)**	1,8-1,9	4,1-4,5
(g) Percentage of energy consumed for crushing **(=b/(a+b))**	~50	~10

Crushing specific energy analysis

- No correlation between jaw crusher specific energy consumption and impact crusher specific energy consumption
- No correlation between specific energy consumption and compressive strength



Influence of the crushing method

	Impact crusher	Jaw crusher
Aggregates geometry	+	-
Grain size distribution	-	+
Fine content	-	+
Cement paste content	No influence	No influence
Water absorption	No influence	No influence
Energy consumption	-	+
Crushing duration	-	+

Thank you for your attention

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