21-04-2022

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SAPPMA QUALITY WORKSHOPS / WEBINARS

SAPPMA WORKSHOP 1 - 16-11-2019

SAPPMA WORKSHOP 2 - 17-07-2019

SAPPMA WORKSHOP 3 - 19-02-2020

SAPPMA WORKSHOP 4 - 22-07-2020

SAPPMA WORKSHOP 5 - 22-10-2020

SAPPMA WEBINAR 1 - 25-02-2021

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SAPPMA WEBINAR 8 - 21-10-2021 - *PETER FISCHER*

SAPPMA WEBINAR 8 - 21-10-2021 - *PROF MARANGONI*

SAPPMA WEBINAR 8 - 21-10-2021 - *MIKE SMART*

SAPPMA WEBINAR 8 - 21-10-2021 - *DARREN*

SAPPMA WEBINAR 9 - 24-11-2021

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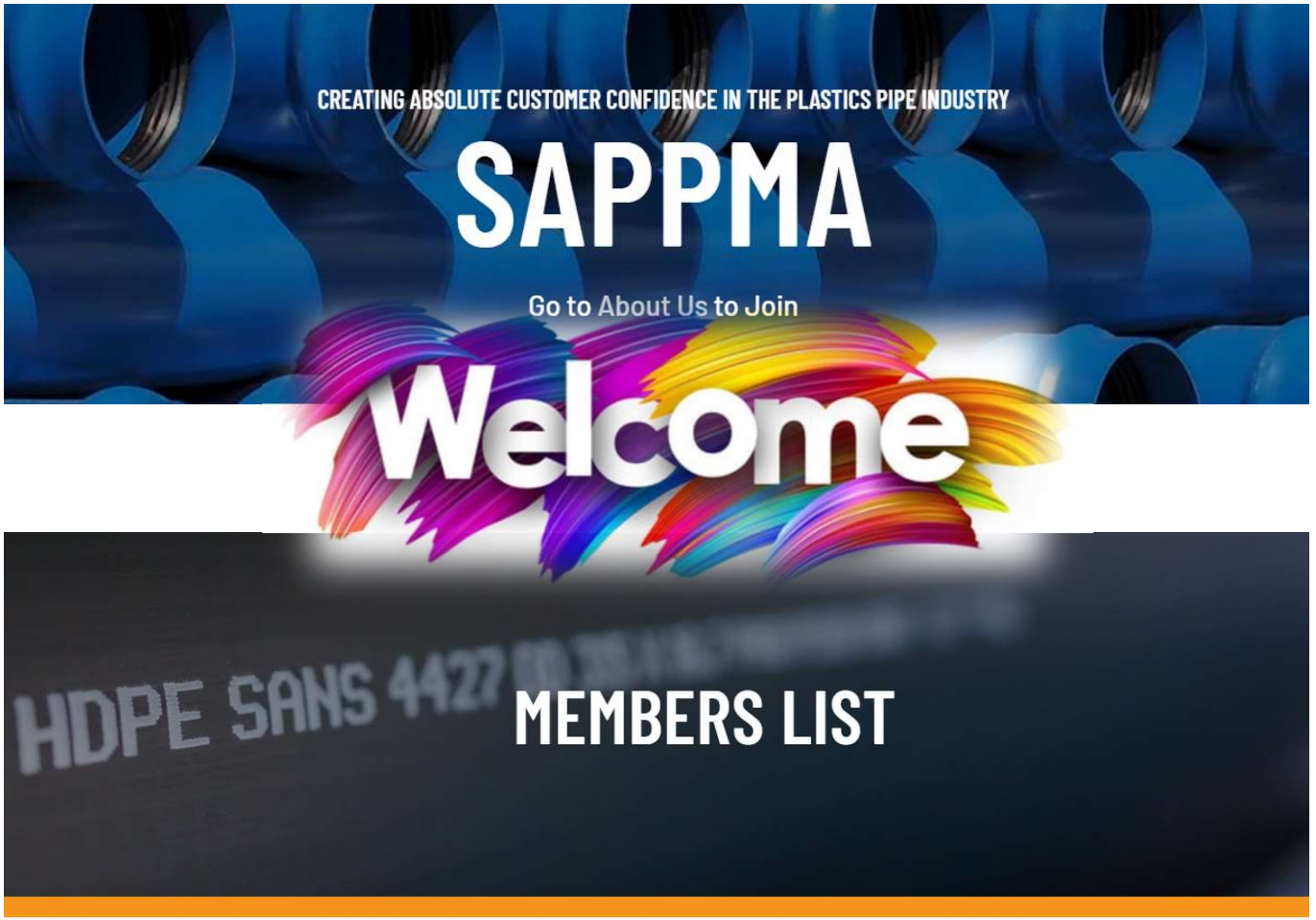
Welcome to the SAPPMA Members and Participants



PIPE MANUFACTURERS

POLYMER MANUFACTURERS

SUPPLIERS

CERTIFICATION BODIES

SPECIALISED MANUFACTURERS

INDIVIDUAL MEMBERS

MEMBERS CATEGORIES

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Presenter

SAPPMA Webinar III

21 April 2022

Deep-dive into the fundamentals of Calcium Carbonate in rigid PVC

omya.com

IDWALA SA a Bud Group Company

THINKING OF TOMORROW

Ali Kalantari

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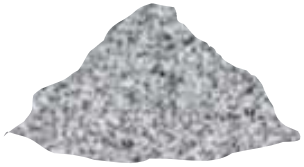
1. What is calcium carbonate and its specifications?
2. Where & how to add it into rigid PVC process?
3. Why do we add calcium carbonate?

- ❑ Thermal stabilizers
- ❑ Lubricants
- ☑ Mineral Modifiers or fillers
- ❑ Flow modifiers
- ❑ Impact modifiers
- ❑ Antioxidants
- ❑ UV stabilizers
- ❑ Pigments/ Masterbatches
- ❑ Flame retardants
- ❑ Foam agents ...



PVC

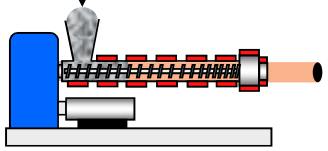
Mixer

Hot

Cold

Feeding system

Pneumatic, Spiral or Screw



Extrusion

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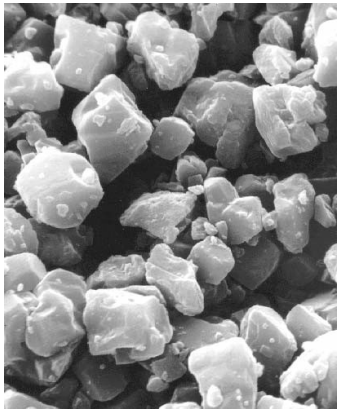
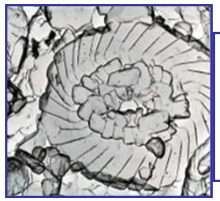
What is calcium carbonate?

Formation:



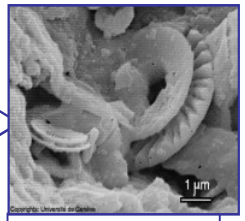
CO_2 + Ca^{2+} + H_2O

Living organisms Bioactivity

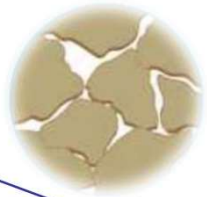


Shells of $CaCO_3$

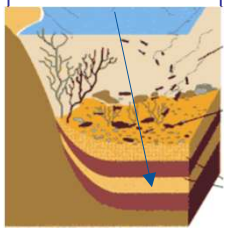
Deposits of Shells on Sea-floor



Sediments



Compaction



Acidic Rain Weathering

Transformation under: High T & P

↓

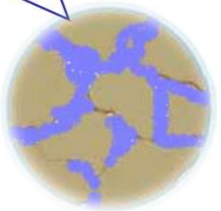
Metamorphic

Chalk

Limestone

Compaction & Cementation

✓ Weak
✓ Porous



Marble

✓ high purity
✓ no porosity
✓ very hard

Erosion

Quarry

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What is rigid PVC?

A Thermoplastic material

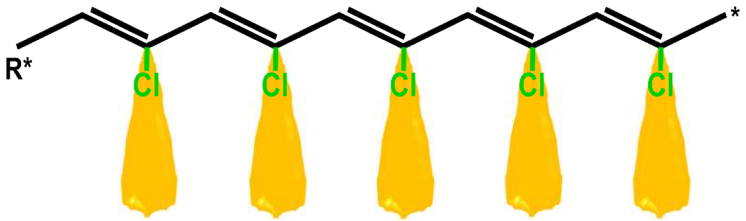
PE / PP

Tg = -100 °C
/ -25 °C

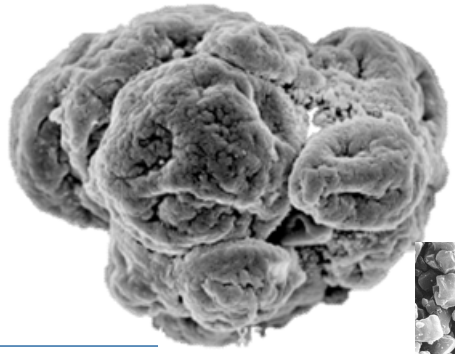
PVC

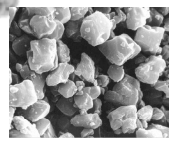
Tg = 87 °C

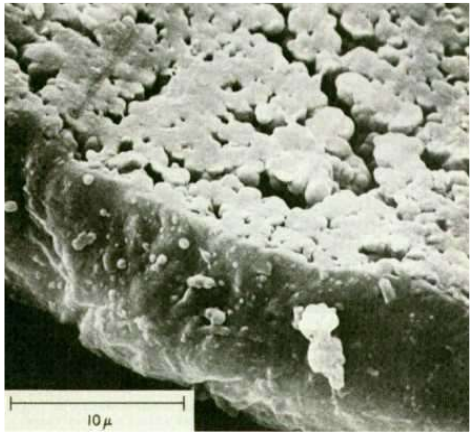
Polyvinylchloride



120 Micron







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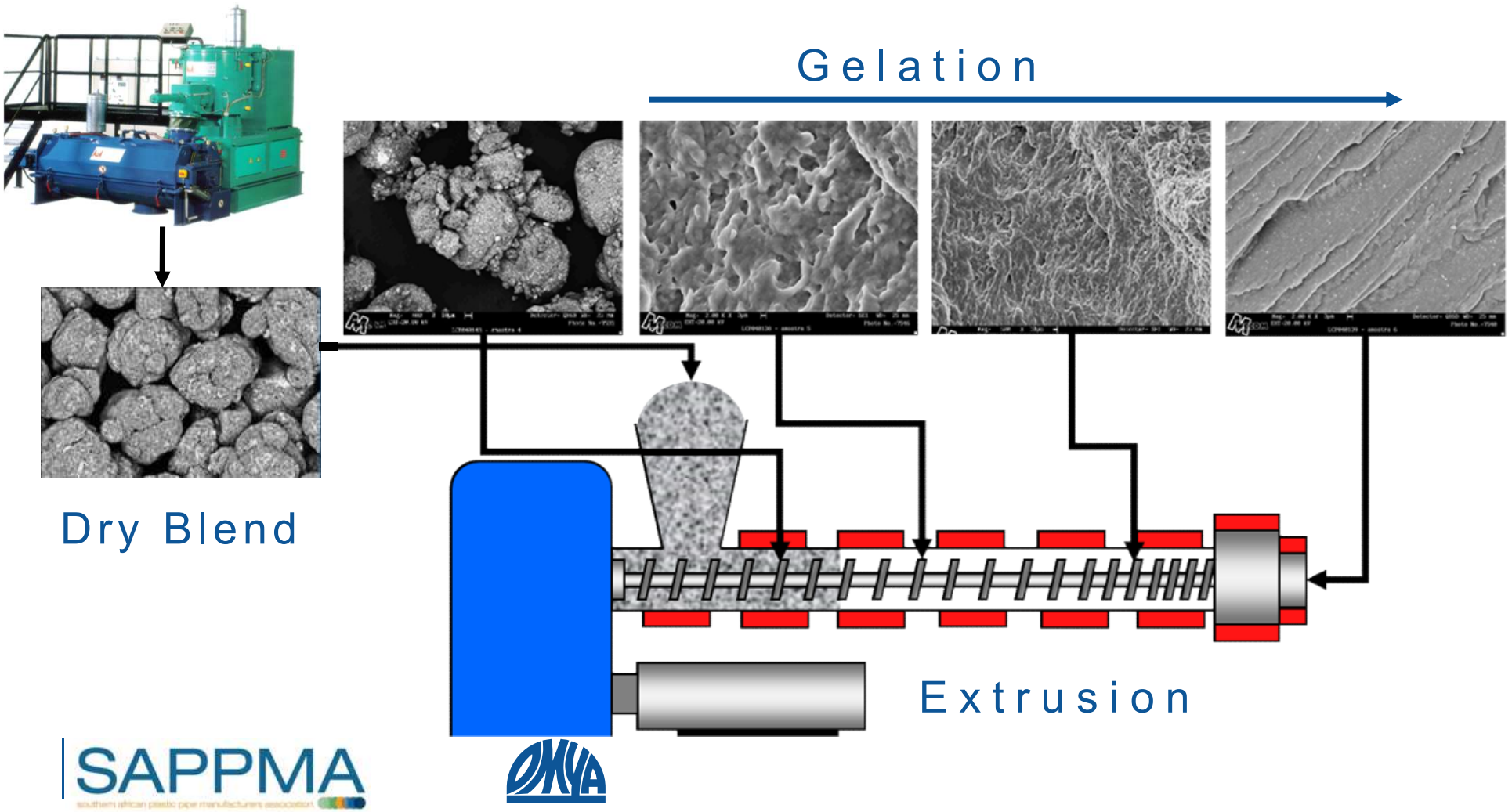
PVC Morphology



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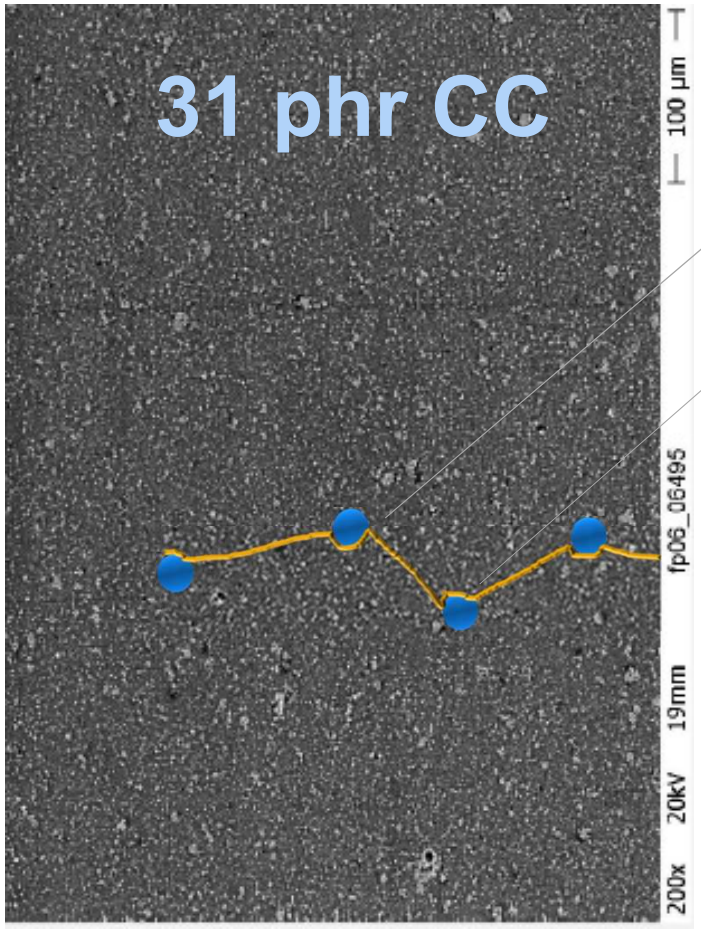
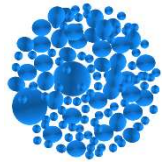
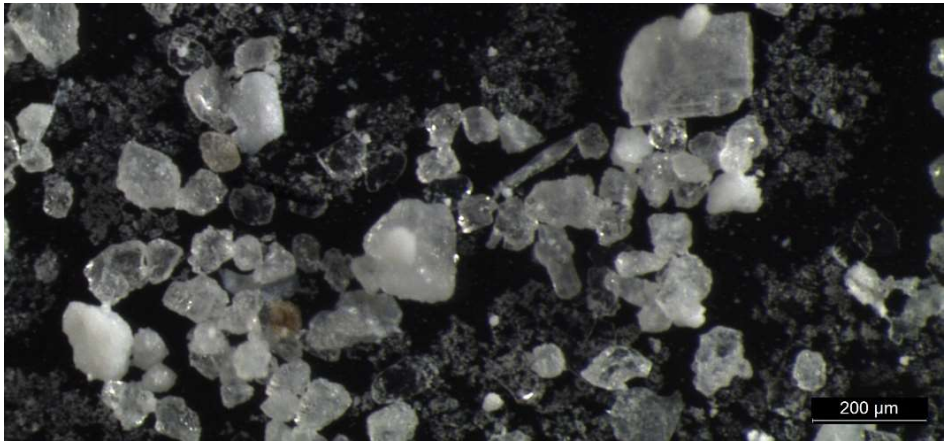
SEM Picture of a pipe's cross-section



Aggregates and Agglomerates



Oversize Particles



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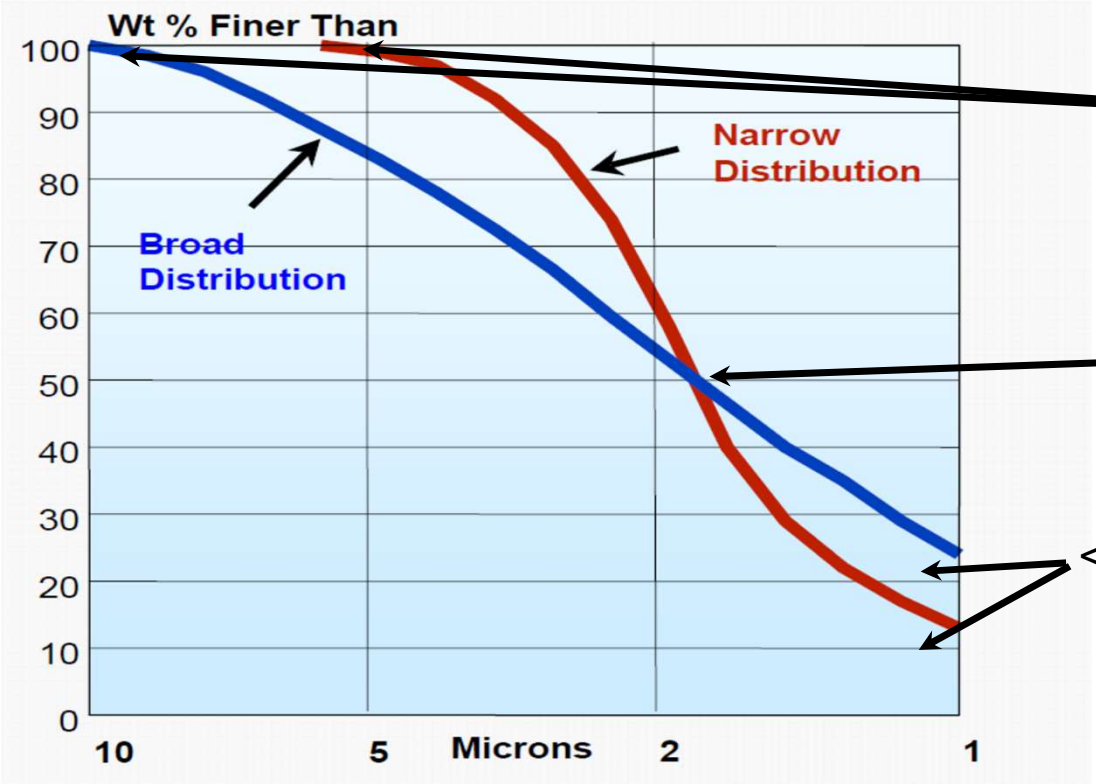
Which specifications of CC?

Particle size and PSD (Cumulative)

- ✓ Chemistry (purity)
- ✓ Whiteness and Brightness

Reduce impact resistance



Raise Agglomerates

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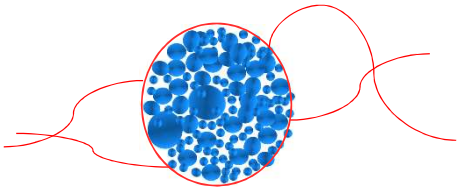
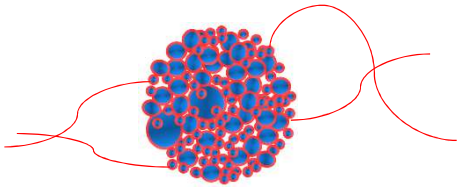
Which specifications of CC?

Agglomerates



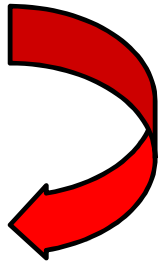
Interface between PVC & CC



Does PVC wet CC?

Surface Energy (mJ/m²)

- CC 105
- Water 73
- Coated CC 50
- PVC 40



Surface Treatment (Coating)

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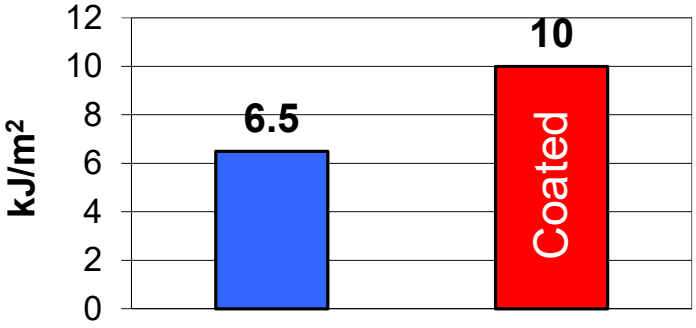
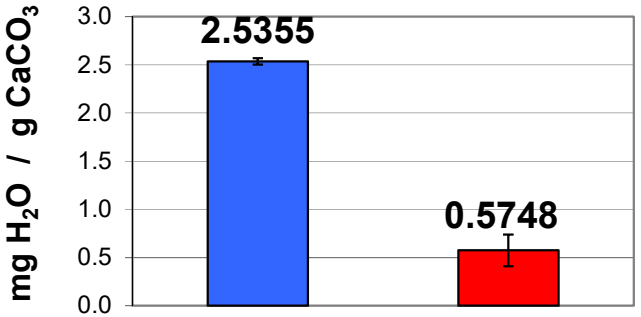
Which specifications of CC?

- Treatment effects

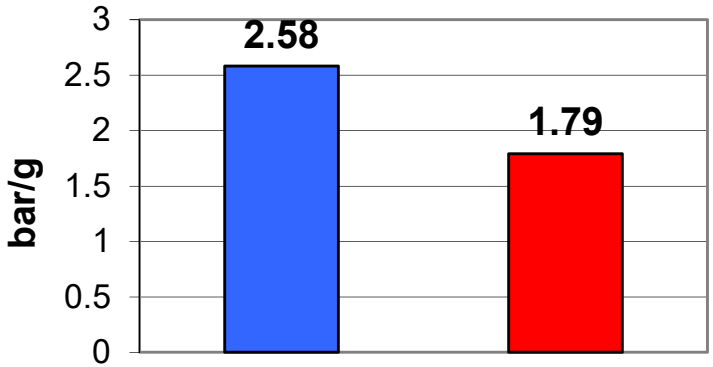
Charpy Impact at 0°C (DIN 53353)



Moisture adsorption (23°C, 10 - 85% RH)



Filter pressure value (14µm sieve)



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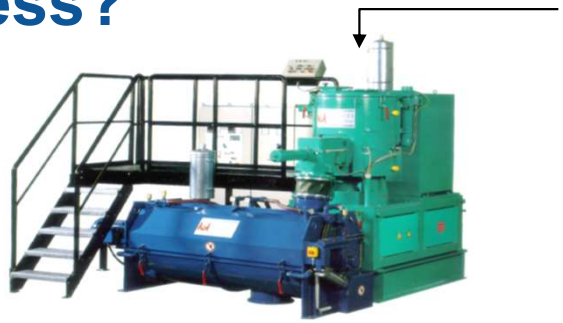
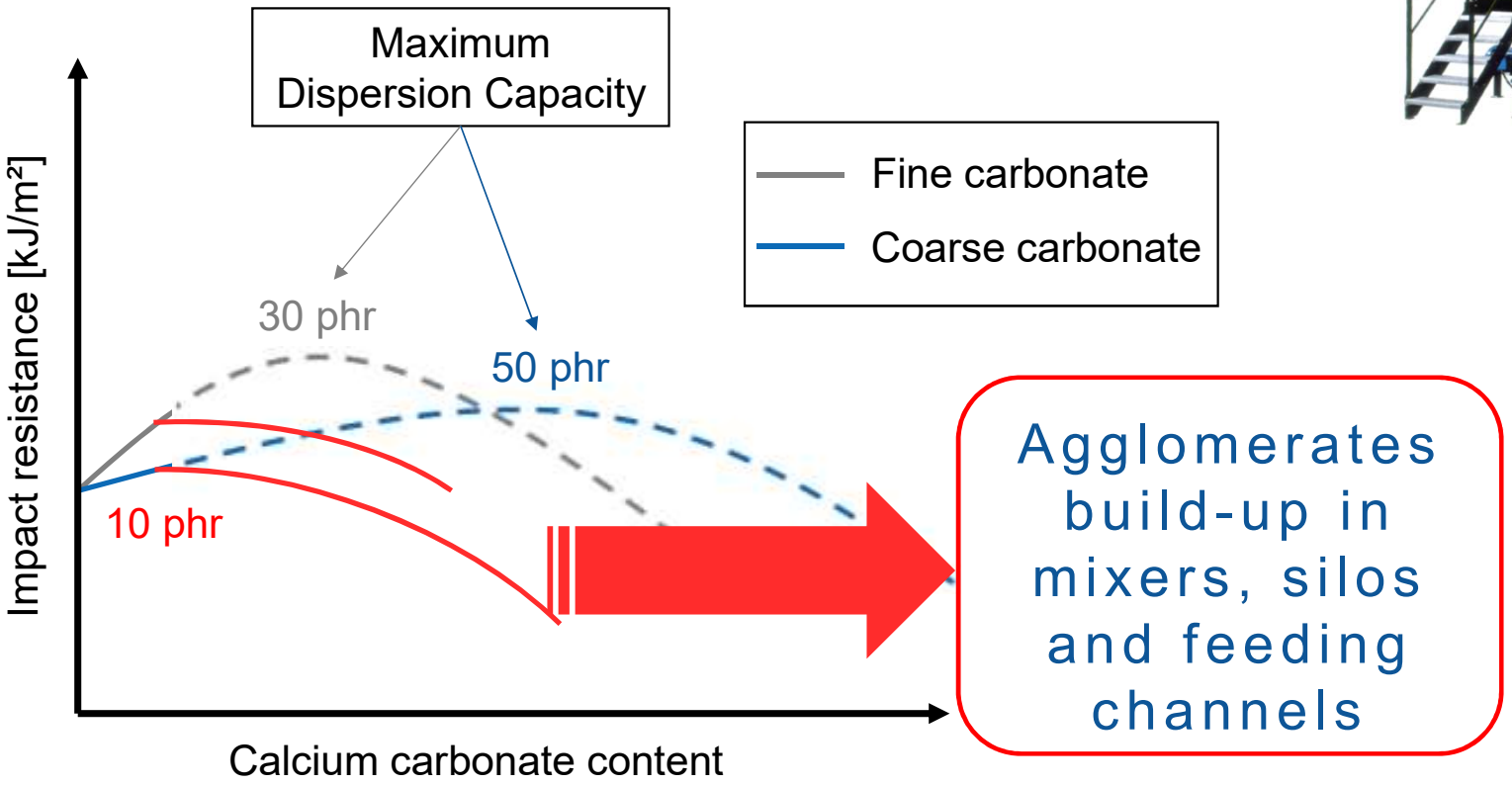
Where & How to add CC in rigid PVC process?

It depends on amount of CC and its particle size!?





Agglomerates build-up in mixers, silos and feeding channels

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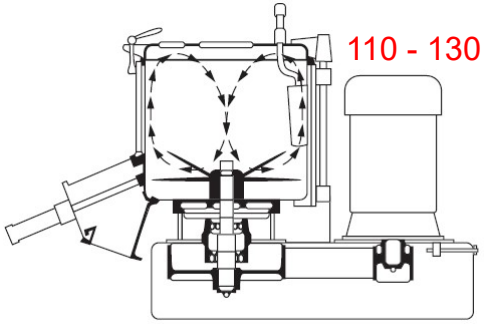
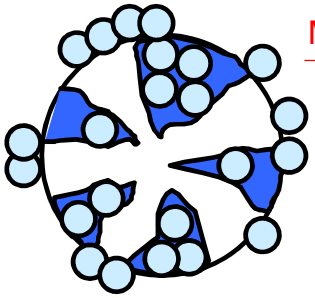
Mixing & Processing



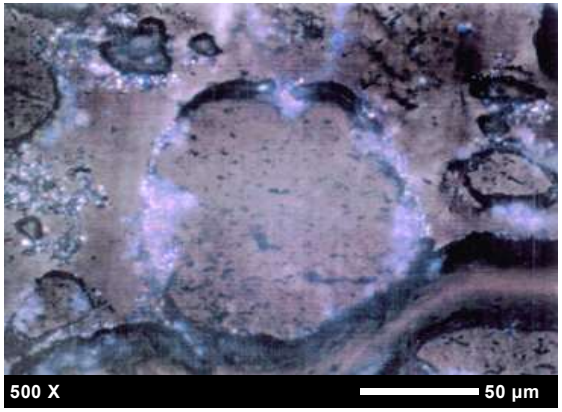
110 - 130 °C

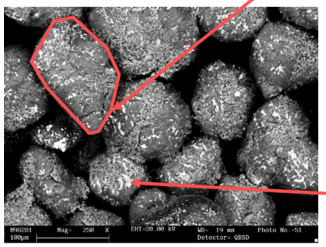
High-Speed Mixer. Courtesy of Thyssen-Henschel.

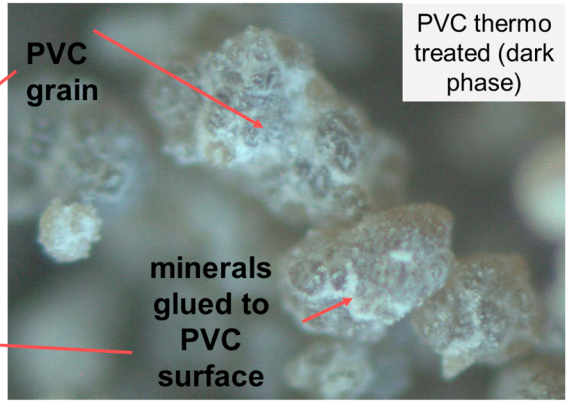
Tg = 87 °C



Max. = 20 phr







- ✓ All $CaCO_3$ is bonded
- ✓ Free flowing
- ✓ Dust free

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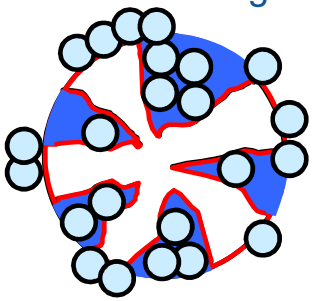
Step by Step addition

PVC, stab & additives heat up to **90 °C**

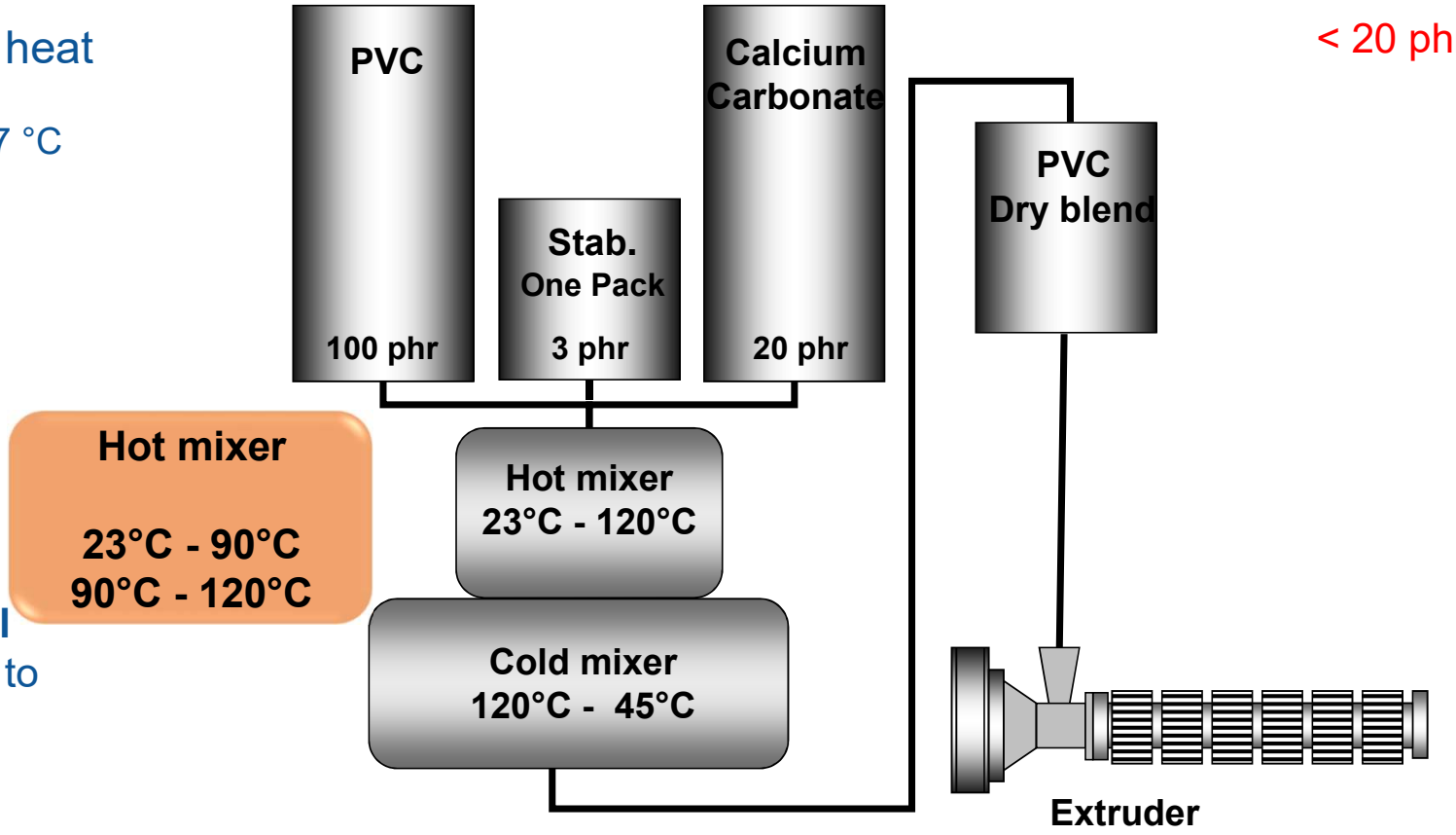
Tg = 87 °C



Addition of CaCO3 and TiO2 up to **20 phr in total** and continuing mixing up to **120 °C**

☑ Separation during **pneumatic** transport of dry-blend; > 10 phr

< 20 phr



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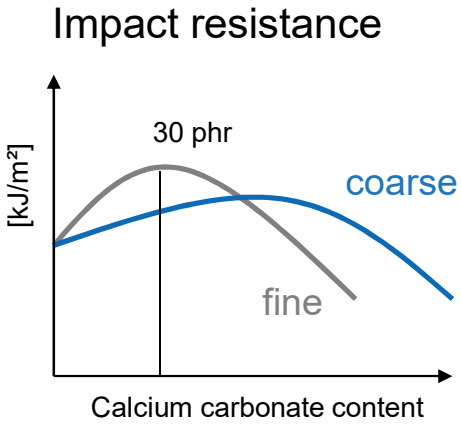
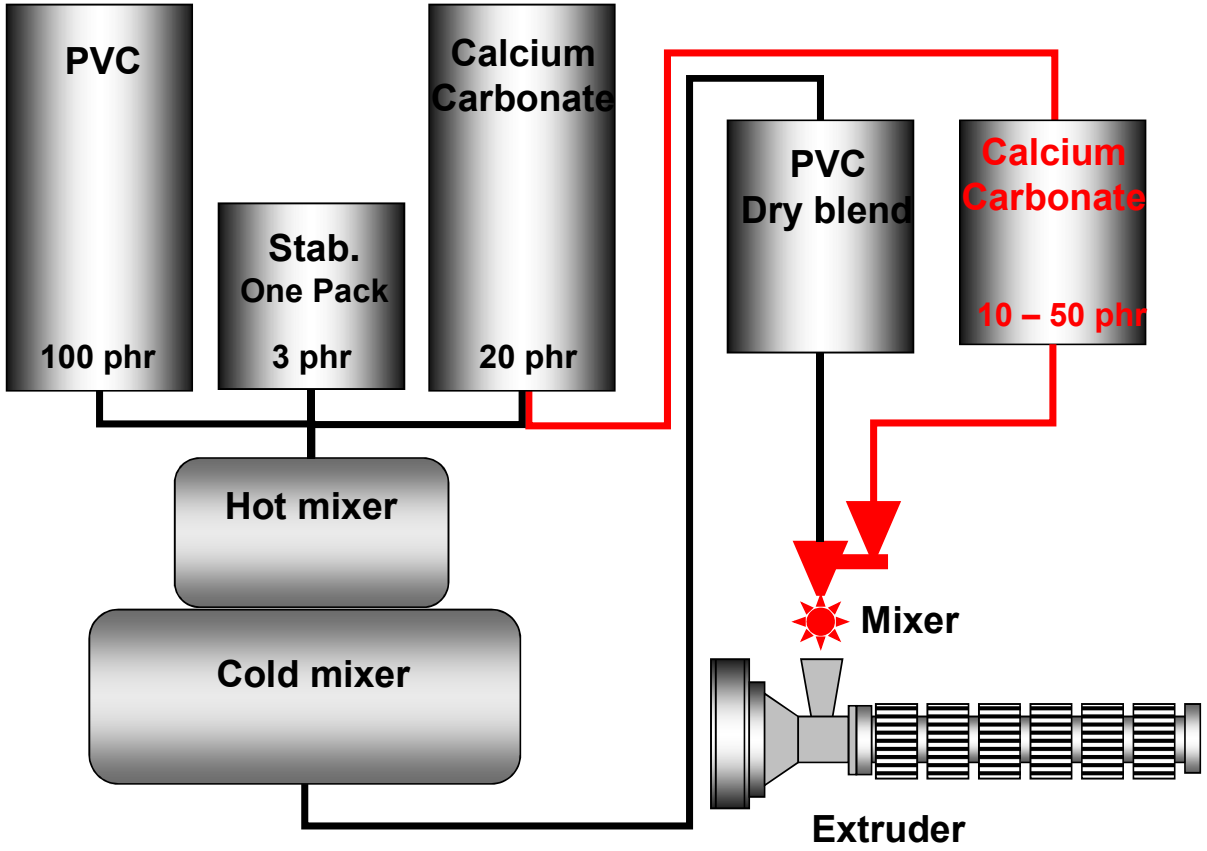
Integrated Direct Addition





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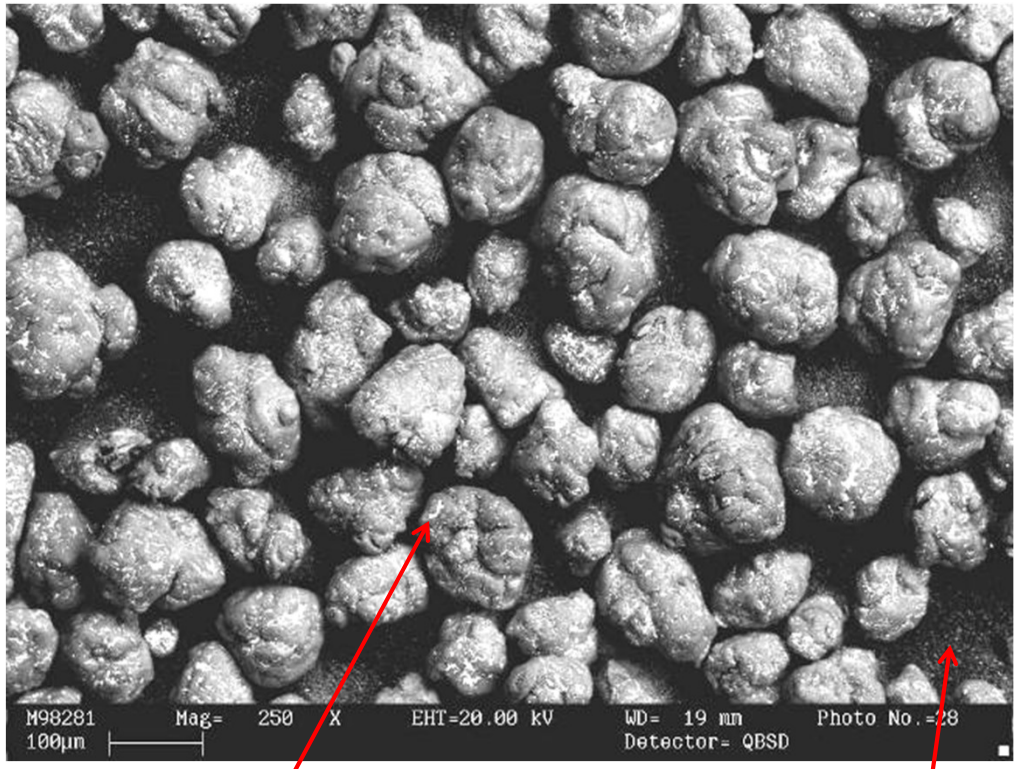
Mixing & Processing



$CaCO_3$ attached

$CaCO_3$ non-attached

- Separation during **pneumatic** transport of dry-blend; > 10 phr
- Separation during **spiral / screw** transport of dry-blend; > 20 phr
- Caking inside the hot mixer and diposite in silo; > 30 phr

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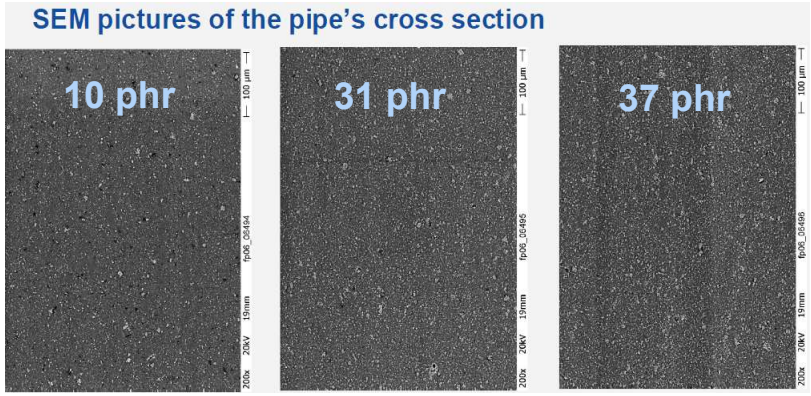
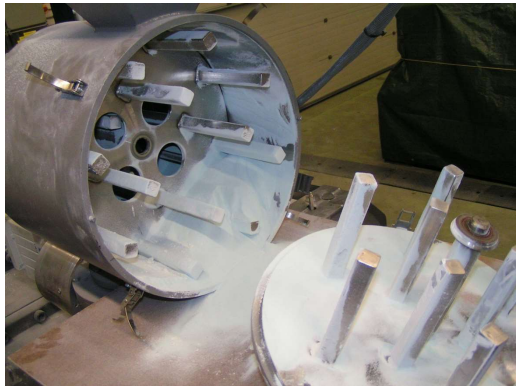
Direct Addition

Video Link

https://www.linkedin.com/showcase/omya-polymers/





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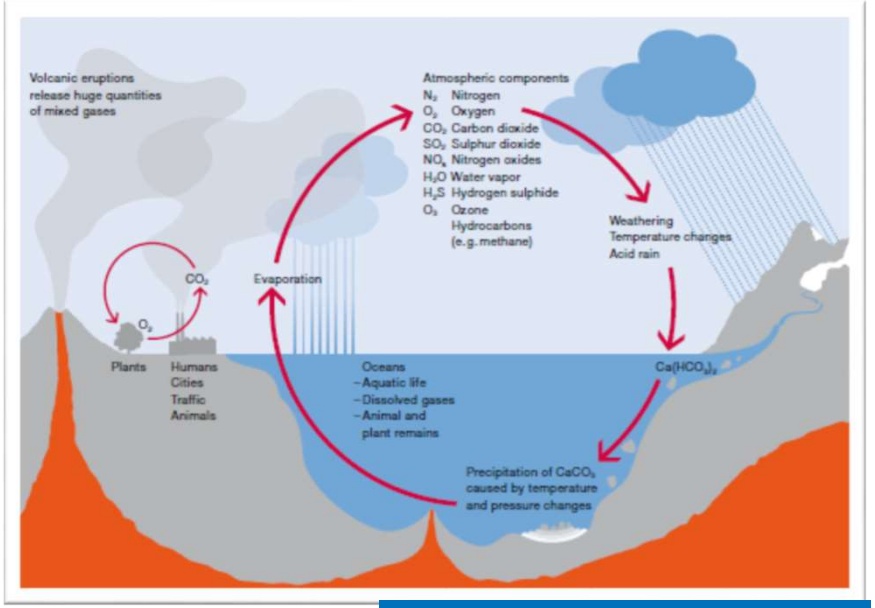
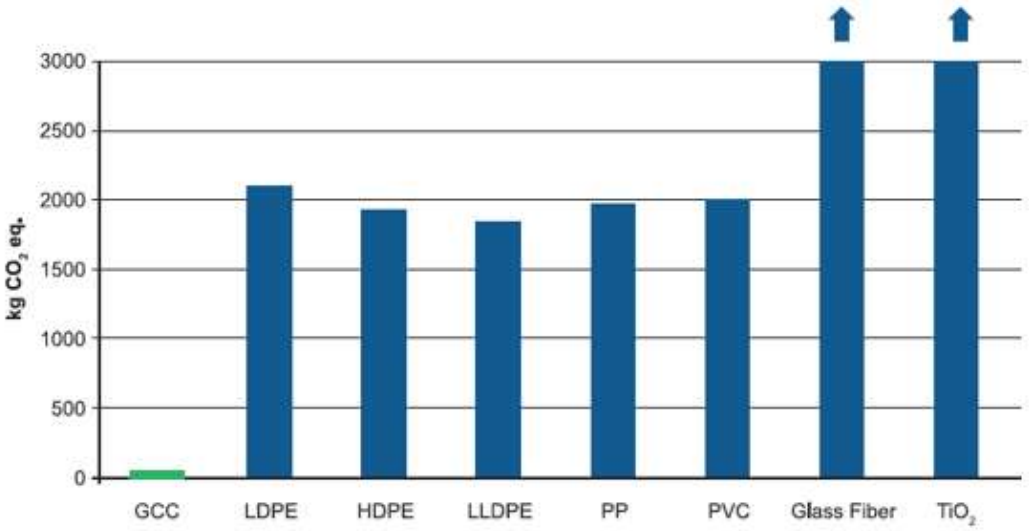
Why do we add calcium carbonate?

❑ Ecological Effects



Natural, renewable and globally available



Carbon footprint of $CaCO_3$

62 kg CO_2eq emitted per ton of natural ground Calcium Carbonate* produced.

*Source: CCA LCI GCC dry, 2014, EU28-Turkey+Norway energy mix.

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Renewability

Ecological Effects

Calcium Carbonate is a renewable raw material

CCA Europe

Calcium Carbonate Association – Europe A.I.S.B.L.
Member of IMA-Europe

March 2016

Around 4 % of earth crust is made of calcium carbonate, making it one of the most common raw materials in nature. Calcium carbonate is ubiquitous in nature and is continuously replenished by means of natural cycles in rivers, lakes & oceans or formed as minerals in the form of shells, skeletons, stalactites and stalagmites. Commercial grades of calcium carbonate are produced from natural sources such as limestone, chalk or marble which are widely available around the world.

While a substantial increase of the use of calcium carbonate has been observed over the last decades, there is no scarcity of calcium carbonate deposits and there are proven reserves/resources for many centuries. More so, adequate and sustainable management practices have been implemented to foster use of resources efficiently. The results of two recent independent university studies[1] conclude that the annual replenishment of calcium carbonate varies from 8.8 to 14.5 billion tons/year in different environments. The annual consumption of calcium carbonate[2] in various markets (infrastructure, cement,…) being in a range of 4.5 Billion t/year, the replenishment rate (according to the ISO 14021 definition) exceeds the consumption rate. Therefore, **calcium carbonate meets the criteria for a renewable material**.

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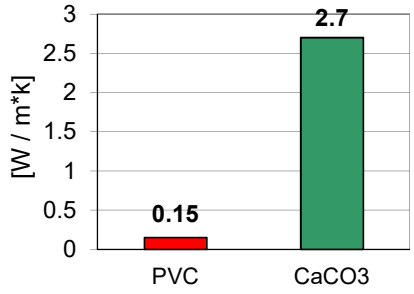
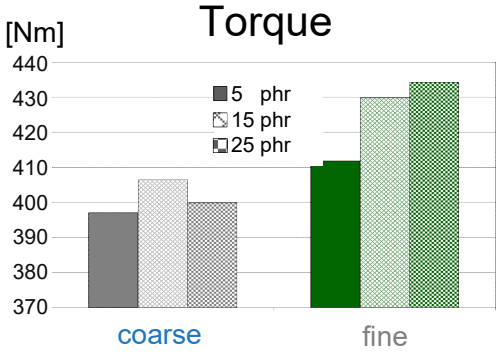
Why do we add calcium carbonate?

Technical Effects

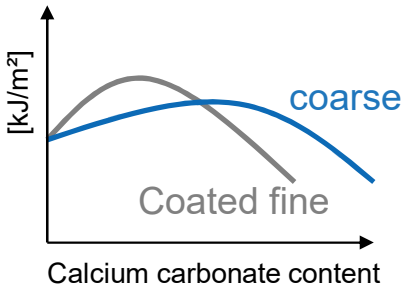
Thermal conductivity



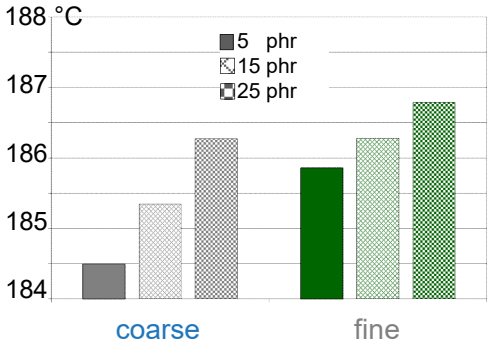
Torque



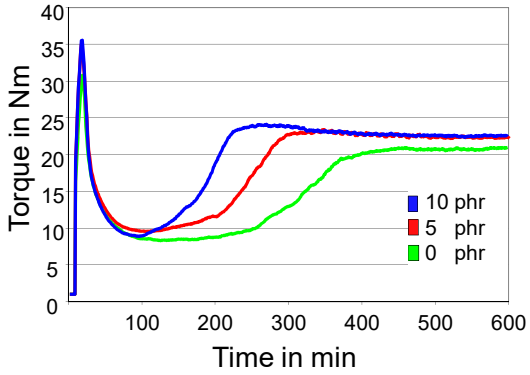
Impact resistance



Melt Temprature



Fusion of PVC – fine CC



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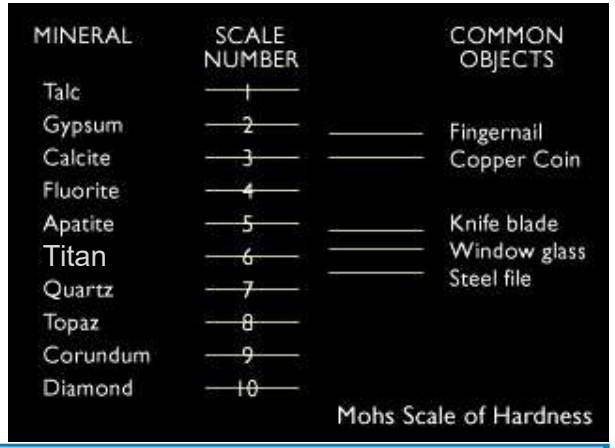
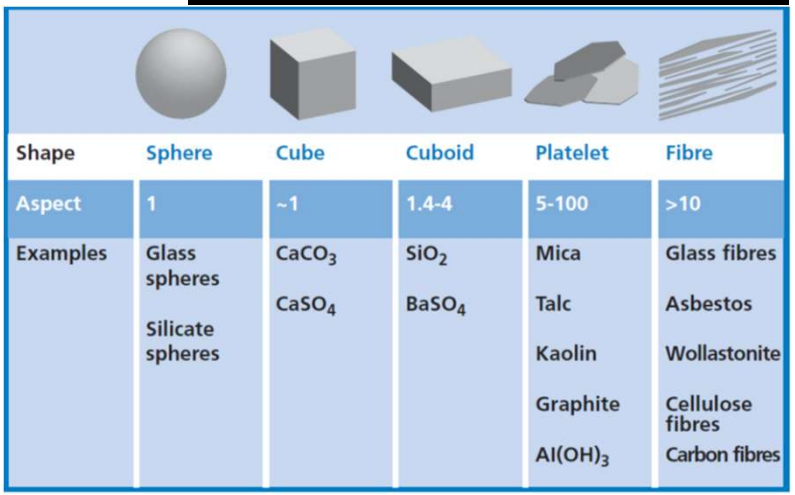
Why do we add calcium carbonate?

Technical Effects

Abrasion

	low abrasion	high abrasion
▪ Aspect Ratio:	~ 1	> 5
▪ Mohs Hardness	1	10
▪ HCl insoluble	< 1%	> 2%
▪ Mid-sise (d50%)	< 1µm	> 5µm
▪ Top Cut (d98%)	< 5µm	> 30µm
▪ Coating	yes	no





Shape	Sphere	Cube	Cuboid	Platelet	Fibre
Aspect	1	~1	1.4-4	5-100	>10
Examples	Glass spheres Silicate spheres	$CaCO_3$ $CaSO_4$	SiO_2 $BaSO_4$	Mica Talc Kaolin Graphite $Al(OH)_3$	Glass fibres Asbestos Wollastonite Cellulose fibres Carbon fibres

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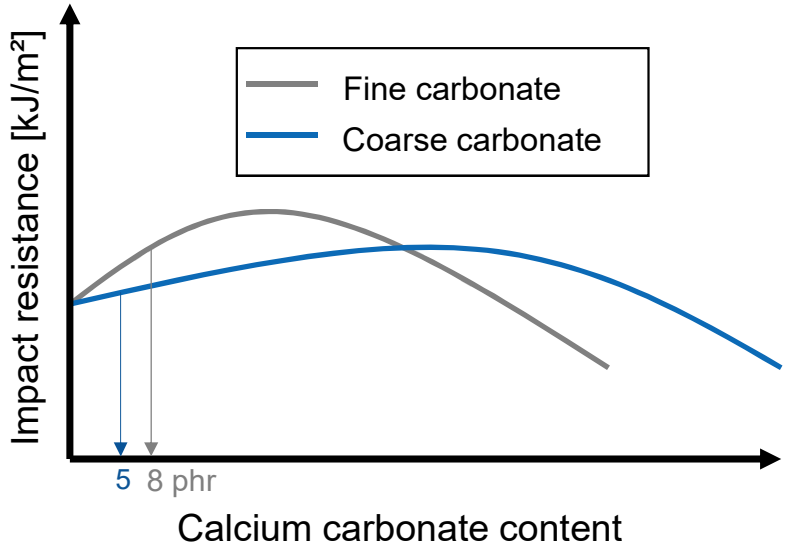
Why do we add calcium carbonate?



❑ Economical Effects ☑

ingredient	density	price	compound A	compound B
	g/cm³	€/Kg	current	new proposal
PVC	1.400	2.000	100.0	100.0
Stabi CaZn	1.300	3.200	4.3	4.3
Stabi Pb	1.600	2.000		
Lubricant 1	1.000	1.000	0.15	0.15
Lubricant 2	1.000	1.000	0.2	0.2
Additive 1	1.000	1.000		
Additive 2	1.000	1.000		
Impact modifier CPE	1.150	2.200		
Impact modifier Acrylate	1.030	2.600	0.0	0.0
Pigment - TiO_2	4.200	2.500	0.5	0.5
Calcium carbonate 2T	2.700	0.200	5.0	
Calcium carbonate 95T	2.700	0.400		8.0
Total weight			110.150	113.150
Total volume			77.057	78.168
Total density [g/cm³]			**1.429**	**1.448**
Results				
Compound -				
Costs per weight		Price €/kg	1.964	1.932
Costs per volume		Price €/liter	2.808	2.796
Difference in costs A - B per weight			0.033 €	
Difference in costs A - B per volume			0.012 €	0.42%
Savings		constant volume calculation		
Total compound quantity with current formulation (mt / year):				10,000
Cost savings € / year			82,314 €	
	density corrected new proposal			

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1. What is calcium carbonate and its specifications?

   Purity, Fineness and Coating

2. Where & how to add it into rigid PVC process?

   Process limitation and Agglomerates build-up in mixers, silos and feeding channels

3. Why do we add calcium carbonate?

   Ecological, Technical and Economical effects

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Questions and Answers

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IDWALA SA a Bud Group Company
THINKING OF TOMORROW

Ali Kalantari

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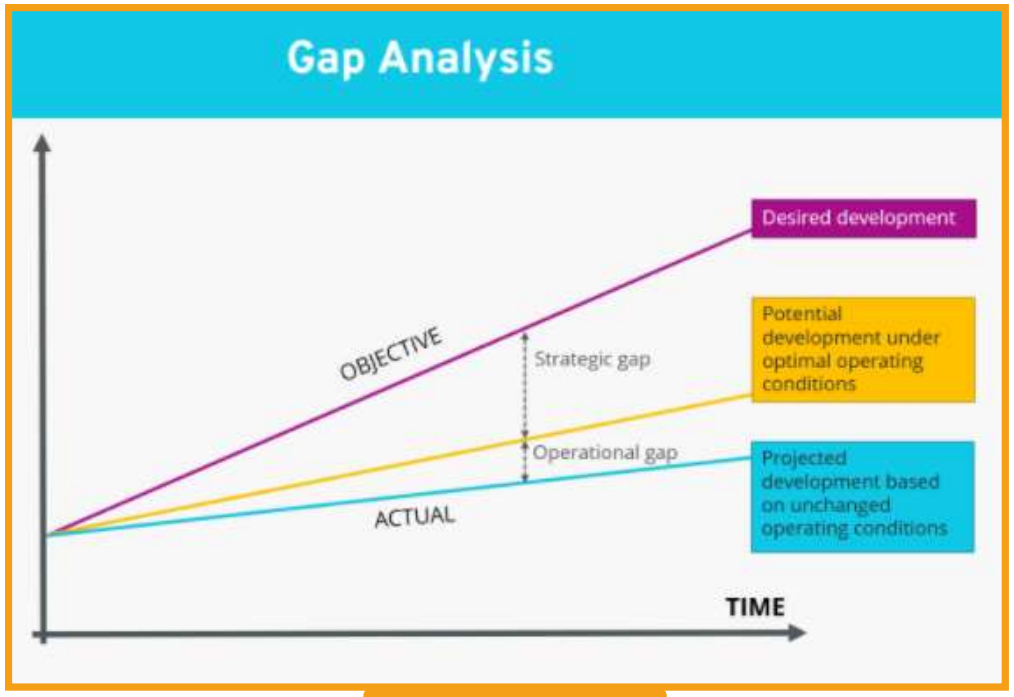
Filling the gap



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