Is Submicron Talc the Future High Cost Performance Nano-Material for Polypropylene Compounds ?

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Function of fine platy minerals in PP

- Reinforcement (stiffness)
- Lower mould shrinkage
- Improved recrystallization of the polymer
- Higher HDT, Vicat etc.
- However, the impact resistance is in most cases negatively influenced

Nano-minerals

- Extraordinary improvements are expected by nanoclays and/or submicron talcs concerning
  - Mechanical
  - Thermal properties
- Nanoclays are used in PA with success
- Submicron talc targets the PP segment
  - First market introduction was made for a 0.6µm (D50) HiTalc® product (in 2001)

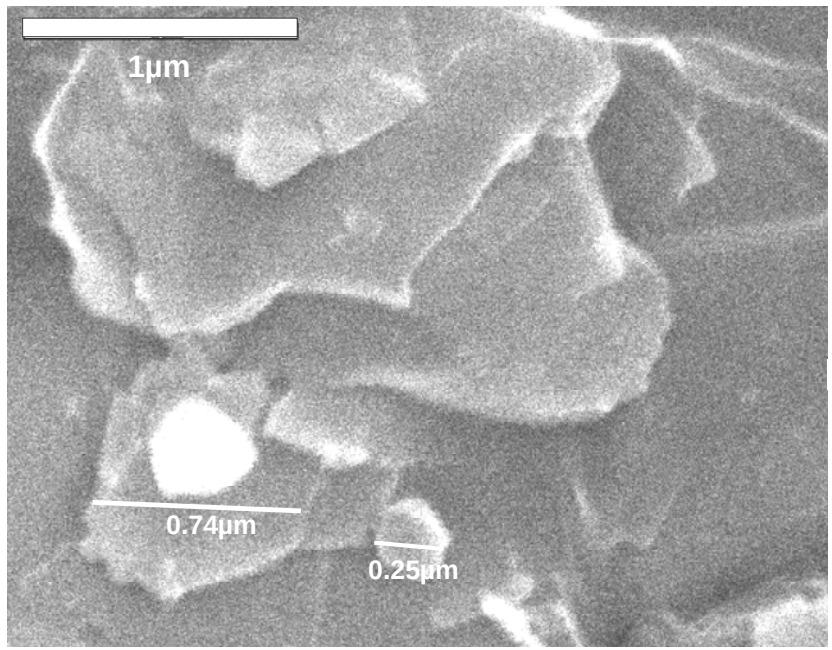
Target of the Study

- Compare a commercially available nanoclay
  - (Cloisite®20A, Southern Clay Product Inc.USA) D50=6µm as dry powder, <100nm after dispersion *with*
- submicron HiTalc® products
  - Medium particle size (D50) of 0.6µm (HTPultra5c)
  - and an experimental product with D50=0.35µm

in a PP-homopolymer compound in order to receive a status-quo in performance data

Novel Technology for Talc <0.5µm

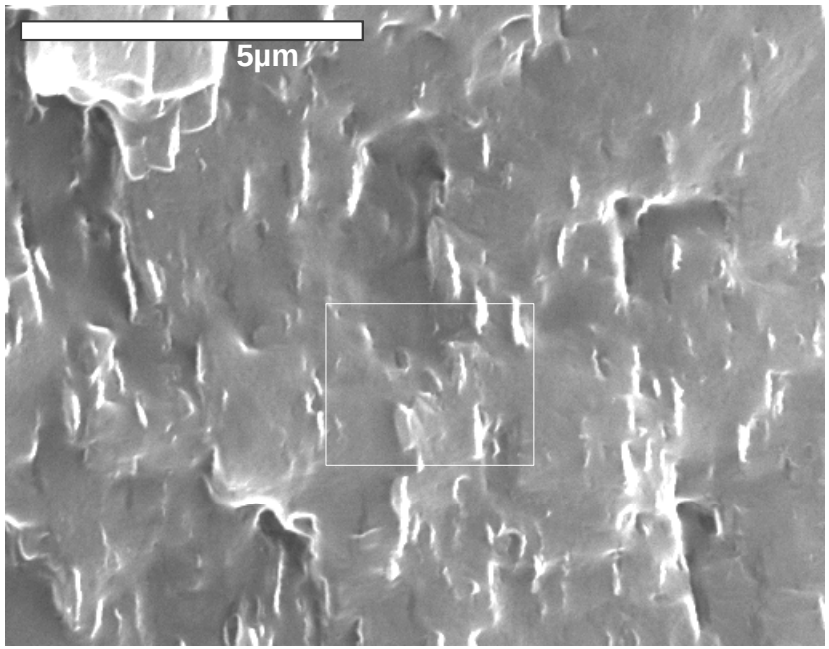
- Common micronized talc products have a D50 of 3 to 1µm
- A new delamination technolgy was investigated for products less than 0.5µm
- This size seems to be the finest possible for dry grinding techniques

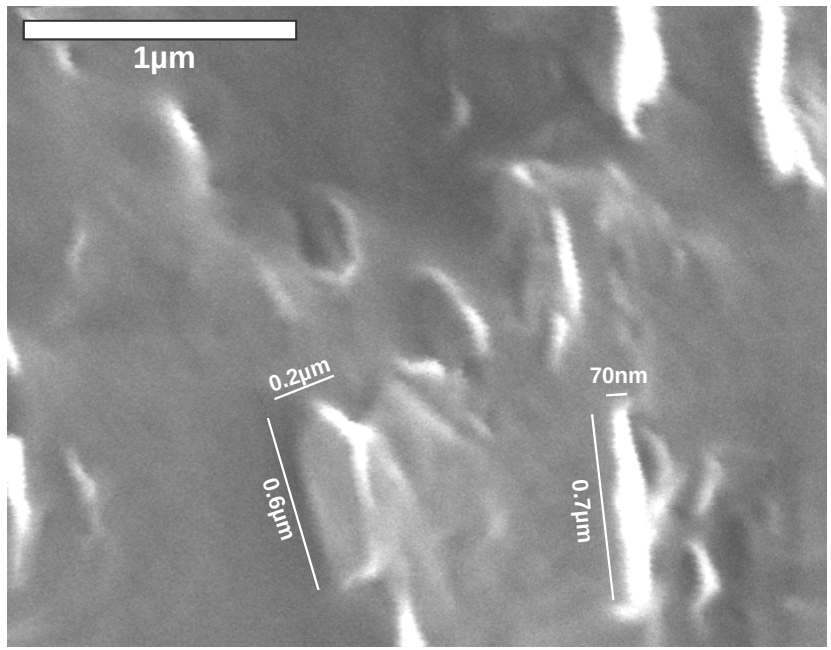


The Test Program

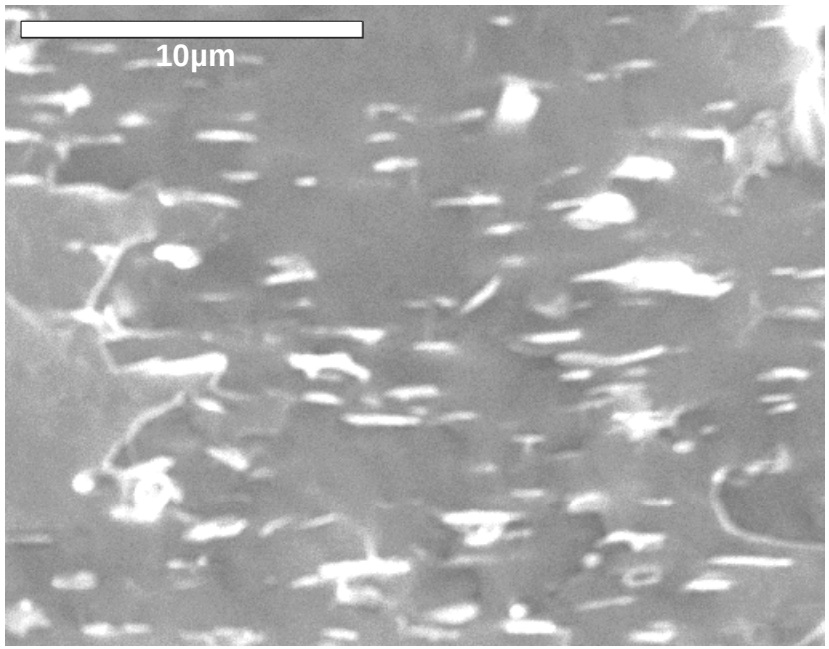
MoplenF30G	100	85	92	92
TPPP		7.5		
IrganoxB225		0.2	0.2	0.2
Nanoclay		7.5		
Talc0.6µm			8	
Talc0.35µm				8
Ash content [%]		4.9	8.0	7.8
Density [g/cm3]	0.899	0.913	0.946	0.935

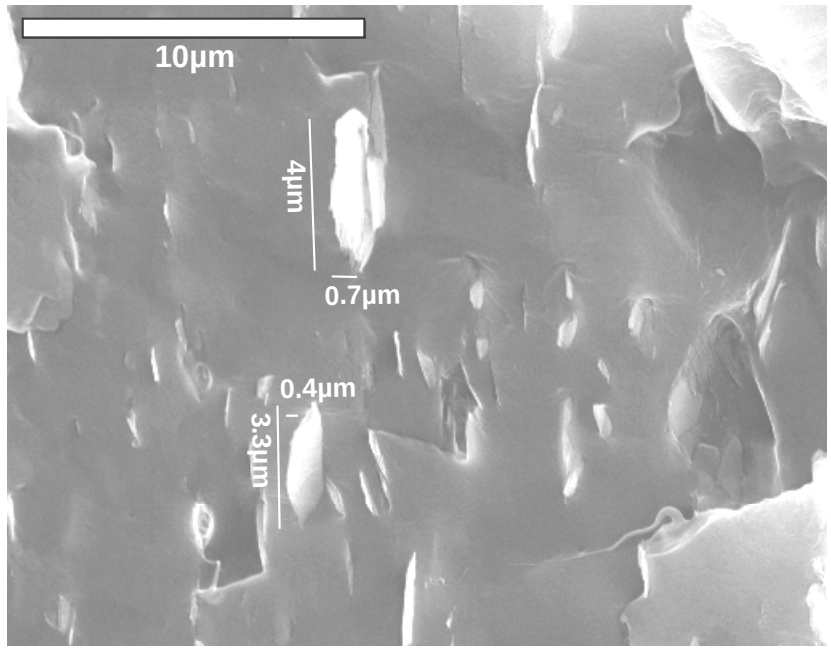
Dispersion of Nanoclay in PP





Dispersion of submicron Talc in PP





Mechanical Properties of filled PP

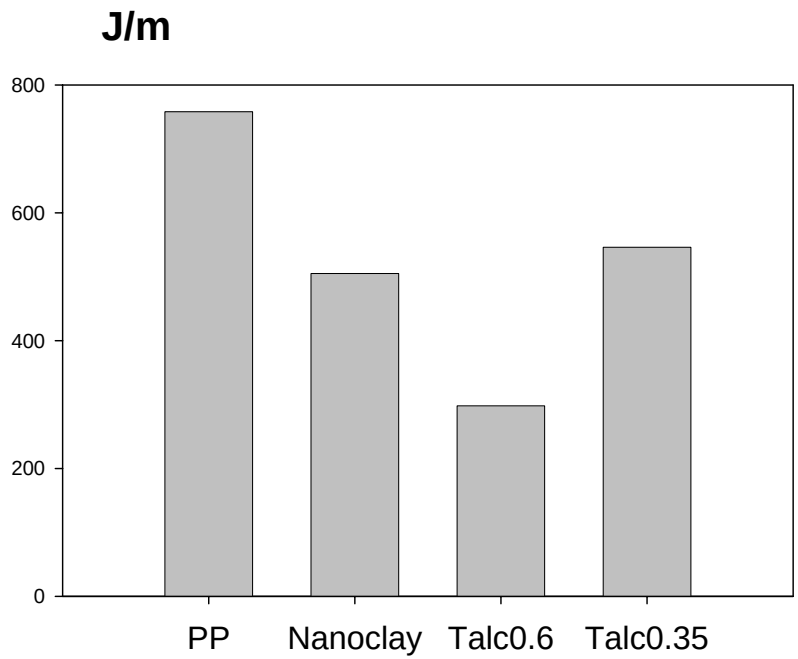
IPF-test results	Unit	PP	Nanoclay	Talc0.6	Talc0.35
Tensile stress at yield	MPa	31,8	36,7	35,0	35,0
Elongation at yield	%	8,9	6,9	6,7	6,7
Tensile stress at break	Mpa		no break	19,9	no break
Elongation at break	%		no break	27,8	no break
Tensile Modulus	Gpa	1,4	2,14	2,13	2,12
Max.Flexural Stress	Mpa	37,8	48,9	47,8	49,5
Flexural Modulus	GPa	1,28	2,23	2,13	2,19

Mechanical & Thermal Properties

IPF-test results	Unit	PP	Nanoclay	Talc0.6	Talc0.35
Notched Impact +23°C	kJ/m^2	3,3	4,3	3,8	4,4
Notched Impact -10°C	kJ/m^2	2,5	2,6	2,7	2,8
HDT A HDT B	°C	53,8 87,3	57,7 108,6	60,8 115,6	61,0 116,4
Ball Indentation Hardness	H132/30 H357/30	53	59	64 63	 64
Melt Volume Rate At 230°C/2,16 kg	cm^3/ 10min	15,8	12,2	20,1	20,3

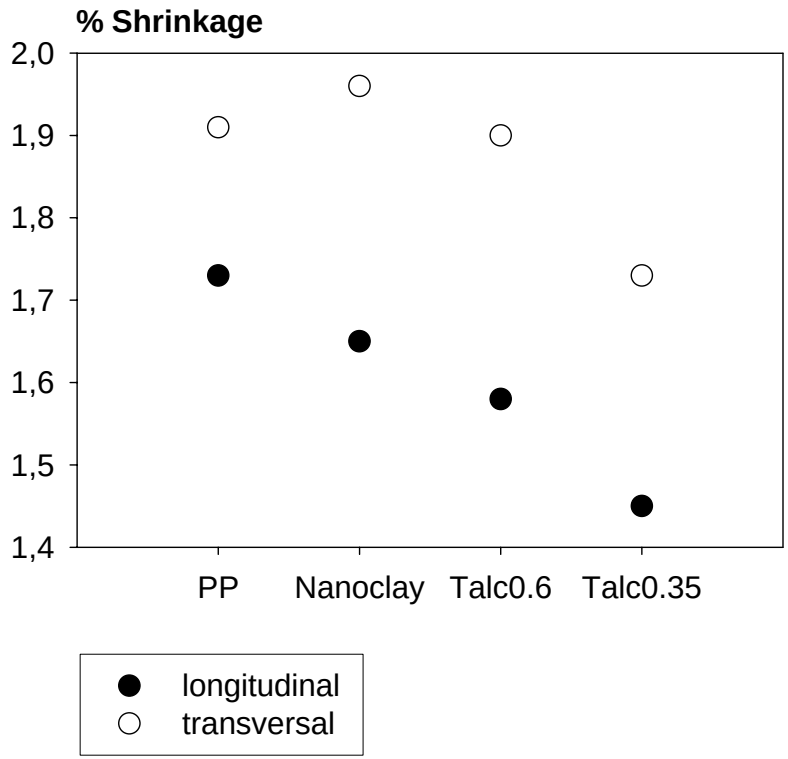
Impact Resistance – unnotched

- The unnotched (ASTM D256) specimens showed a lot of differences between the mineral filled compounds



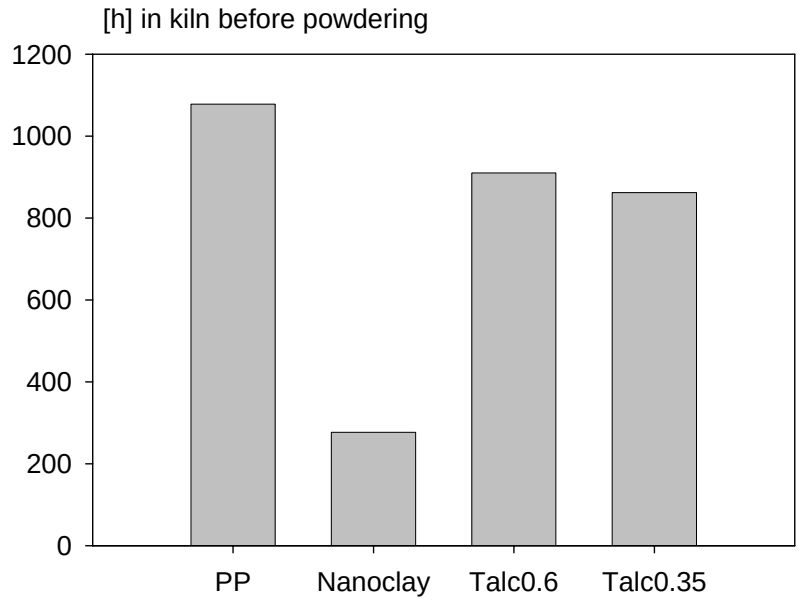
Dimension Stability – Mould Shrinkage

- The mould shrinkage depends on filler level and fineness.
- It is a surprising result that there is so much difference between these three fillers



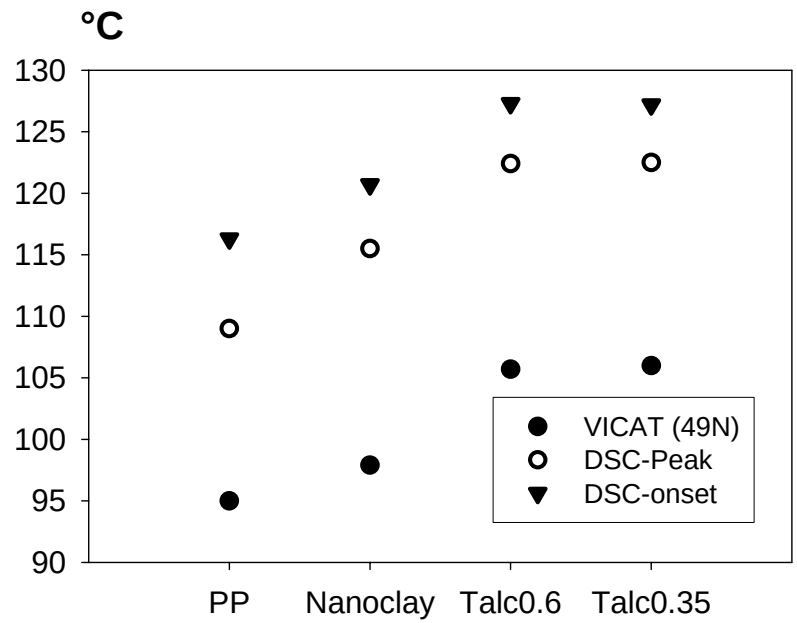
Thermal Stability of Compounds at 150°C

- The heat ageing properties of this nanoclay filled system were poor
- Talc products of such a purity normally show a good behaviour, however, increasing fineness and specific surface reduces the resistance

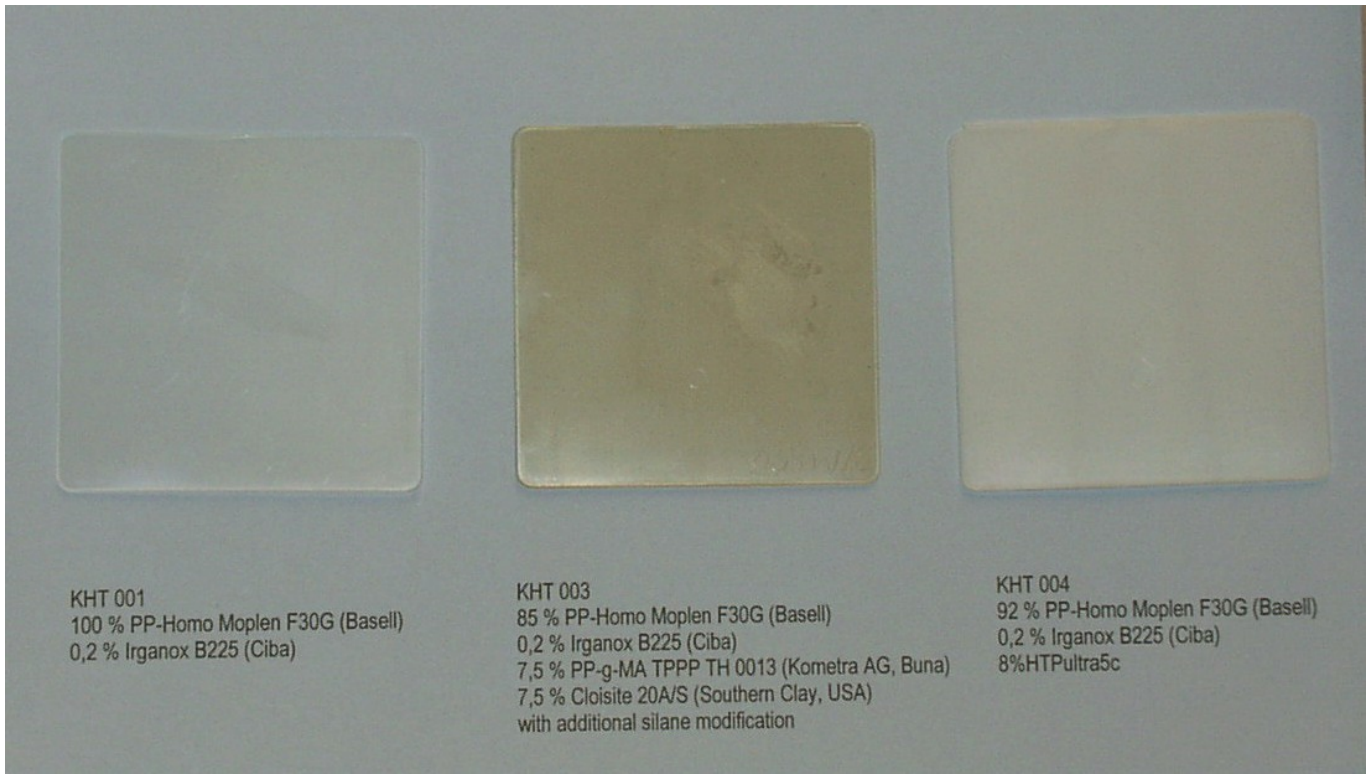


Thermal Properties of Compounds

- The difference in re-crystallization temperature between submicron talcs and nanoclay is significant
- The same effect was found for the VICAT

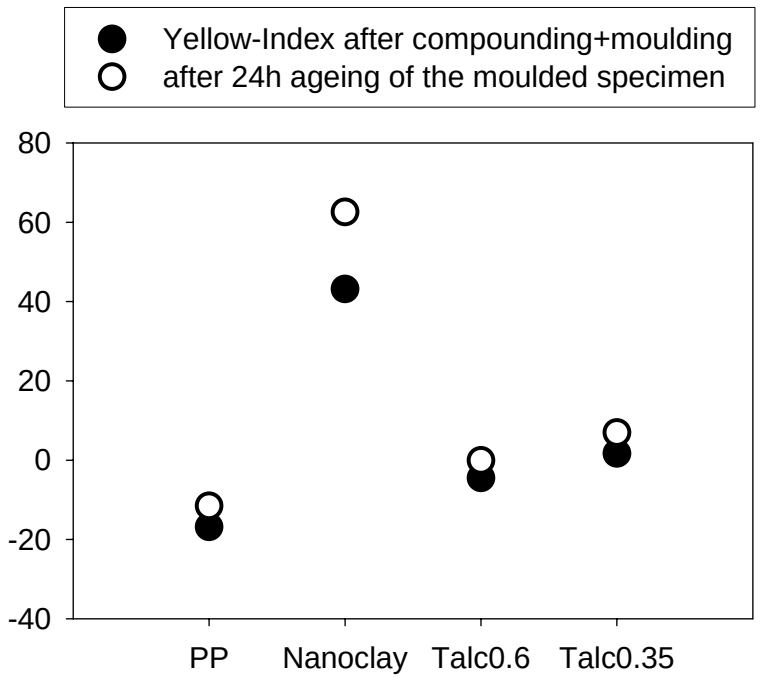


Colour of compounded material pure PP/Nanoclay-/Talc-filled



Yellowing of Compounds

- The colour of the compounds is primarily determined by the filler
- Nanoclays are generally more brownish and pure talc grades are white
- The yellowing effect of nanoclay after 24 hours oven ageing at 150°C is significant



Conclusions

- Submicron talc of 0.35 µm is equal in mechanical properties compared with the selected nanoclay, some thermal features are superior
- There is some more work needed to make these 0.35µm talc products commercially available in industrial scale at reasonable prices

Thank you for your attention !

This paper was prepared and presented by schoconsult GmbH on behalf of
HiTalc Marketing & Technology GmbH, Graz-Austria
see also www.hitalc.com