

Advanced compounding strategies to avoid injection moulding pitfalls

A presentation for Federazione
gomma plastica Milano



Contents

- The Injection Moulding Process
 - ⇒ Compounds and requirements
- The Additives
 - ⇒ Choosing better process additives
- The Benefits available

Injection Moulding

- Suited for high numbers of parts
 - Multiple mould cavities are common
 - Good flow properties are required



Injection Moulding

- High precision components
 - Seals, O rings,
 - Gaskets and bellows,
 - Metal bonded parts
 - Rubber compounds must be well mixed



Injection Moulding

- Highly automated process
 - Short production cycles are used
 - Robotised demoulding
 - High uniformity of produced parts



Injection Moulding Compounds

Key Requirements

- ✓ Must have high level of dispersion
- ✓ Need to have good flow properties
- ✓ A fast cure rate is required
- ✓ Must release easily from the mould
- ✓ Should be low in mould fouling

Process Additives for Injection Moulding

Many types of materials are offered to improve all aspects of mixing and especially flow properties

It is important that the additives do not adversely affect compound quality. An understanding of their action is needed

- Fatty acids
- Functional fatty acids – metal soaps
- Silicones
- Organosilicones

Are all widely used as lubricants or release agents for injection moulding

Requirements of Process Additives

To improve flow and release during high shear processing

- ✓ Best effect is obtained when the process additive is added later in the mixing cycle
- ? However the process additive must also be well dispersed in the compound
- ⇒ With low temperature and low shear mixing of soft compounds this may be a concern

Relevant Testing is Required

✓ Mooney Viscosity

- ⇒ Only as a simple ranking or for basic QC
- ⇒ Fixed shear rate

✓ Rubber Process Analyser

- ⇒ More useful as shear rate can be varied

✓ Capillary Rheometer

- ⇒ Effective over wide shear rate
- ⇒ Time consuming test

✓ Injection Moulding Trial

- ⇒ Gives direct indication of performance

Schill + Seilacher can make all the above tests!

Can your supplier do the same?



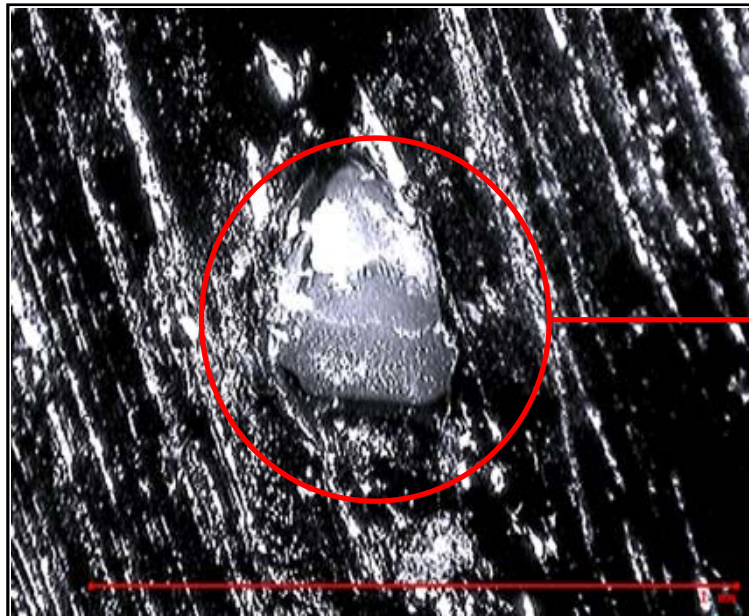
Struktol WB 16 an Additive for Injection Moulding

- ⇒ WB 16 is widely used as a lubricant for improved flow and release properties.
- ⇒ It is high in polarity and is surface acting
- ⇒ It is very effective in synthetic polymers
- ⇒ It is highly crystalline and has a sharp melting point (ca 102 °C)



For best effect WB 16 should be added towards the end of mixing

Process Additive Dispersibility



Poorly dispersed
aggregate of a
process additive
material found in a
low viscosity
compound

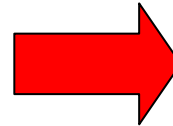
Struktol HT Products

A new range of products developed to offer **added advantages**

- ✓ Several products have **improved dispersing nature**
- ✓ **Easier dispersibility at lower temperatures**
- ✓ Can be mixed into **soft compounds** or at **end of mixing**

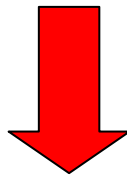
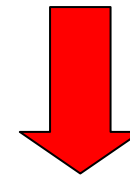
HT Product	Standard Product
HT 202	A 50P
HT 204	WB 16
HT 266	EF 44
HT 503	Aktivator 73-A



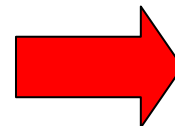


HT Product offers improved safety for use in soft compounds or low viscosity compounds when added at the end of mixing or in mill mixing.

HT product will disperse at temperatures above 60°C



Better / faster dispersion of HT variant compared to standard process additive grades



Result

Improved flexibility

Improved safety

Improved performance

Ingredient	Control	WB 16 FI	WB 16	HT 204
CR (Type W)	100	100	100	100
ODPA	2	2	2	2
AFD	1	1	1	1
N-990	35	35	35	35
Struktol KW 400	30	30	30	30
Struktol Zimag 29/43	8	8	8	8
Struktol WB 16 Flake		3		
Struktol WB 16 Microbead			3	
Struktol HT 204				3
DOTG	1	1	1	1
CBS	1	1	1	1
Sulphur	0.5	0.5	0.5	0.5

Single stage mixing in laboratory Banbury.

Process additives added late after 2' 45" – together with curatives

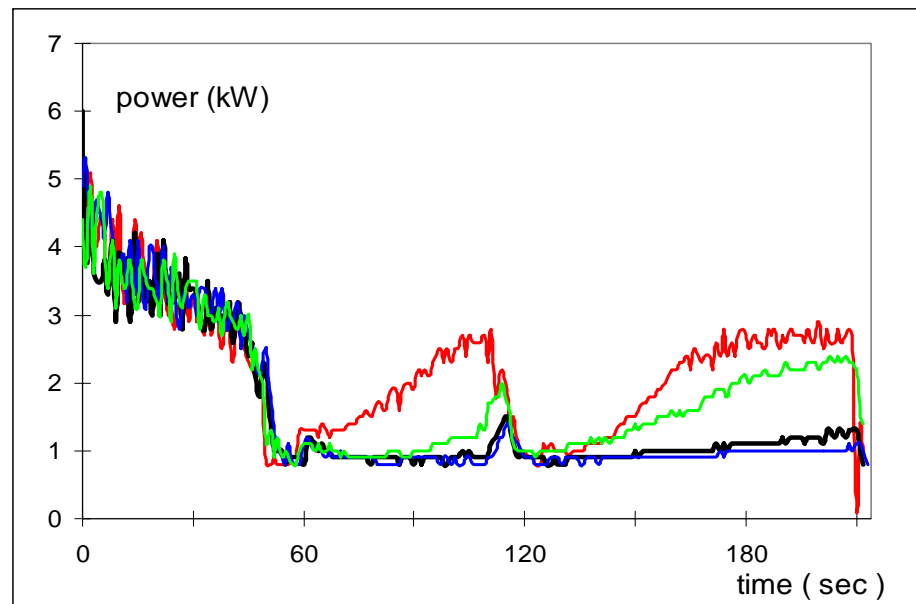
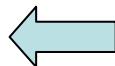
Dump at 3' 30"



Mixing energy is reduced due to presence of WB 16 types.

Rotor slippage occurs due to insufficient WB 16 dispersion.

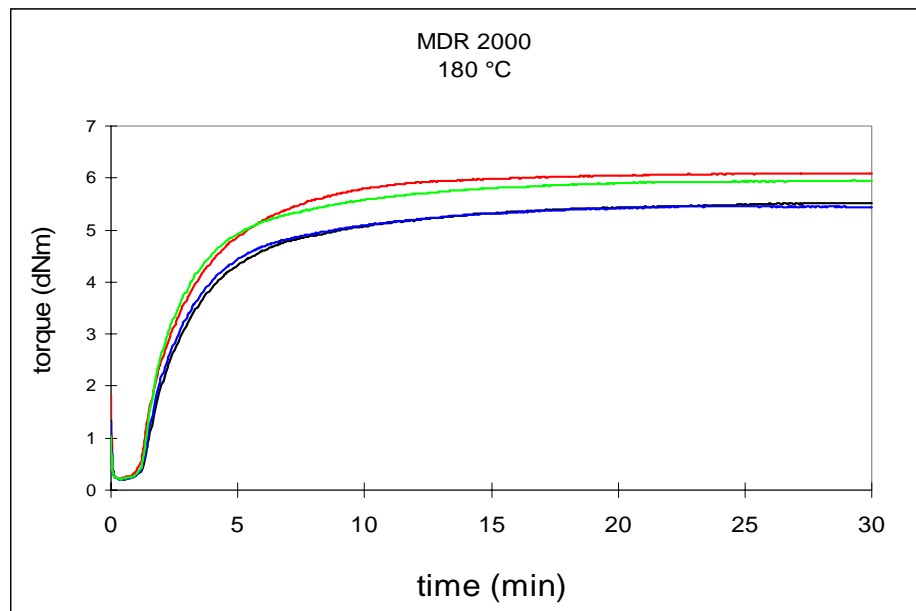
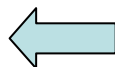
Low temperature generation

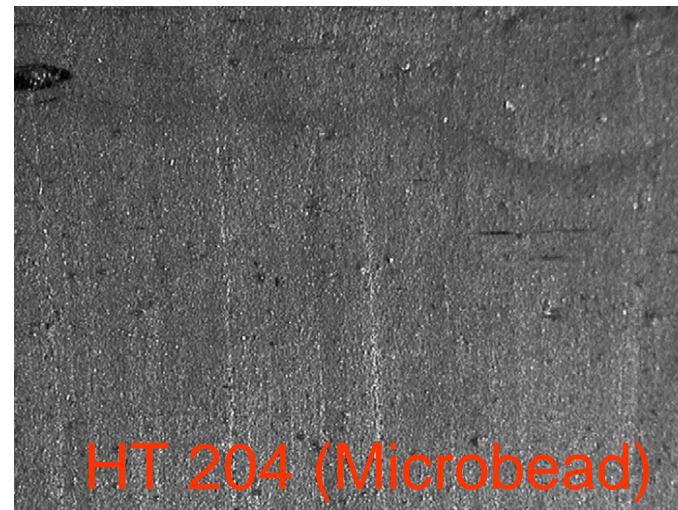
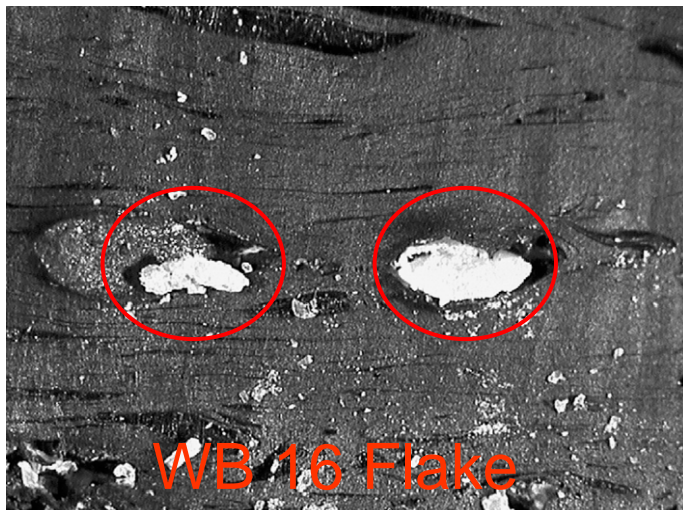
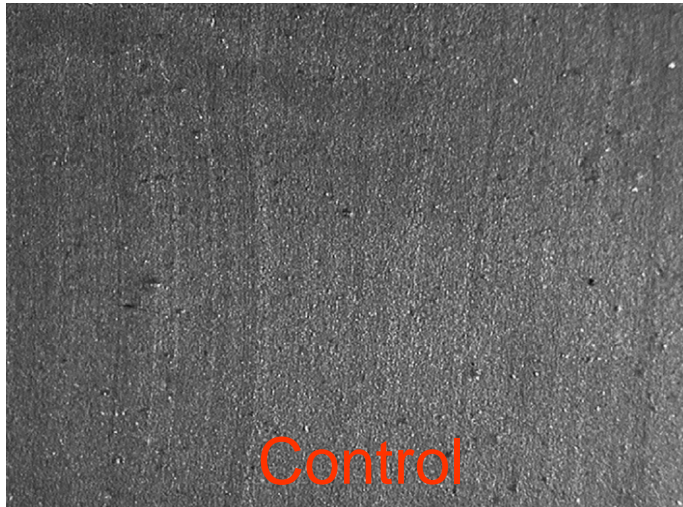


Control — WB 16 FI — WB 16 — HT 204 - -

Cure curves show reduced max torque with WB 16 variants.

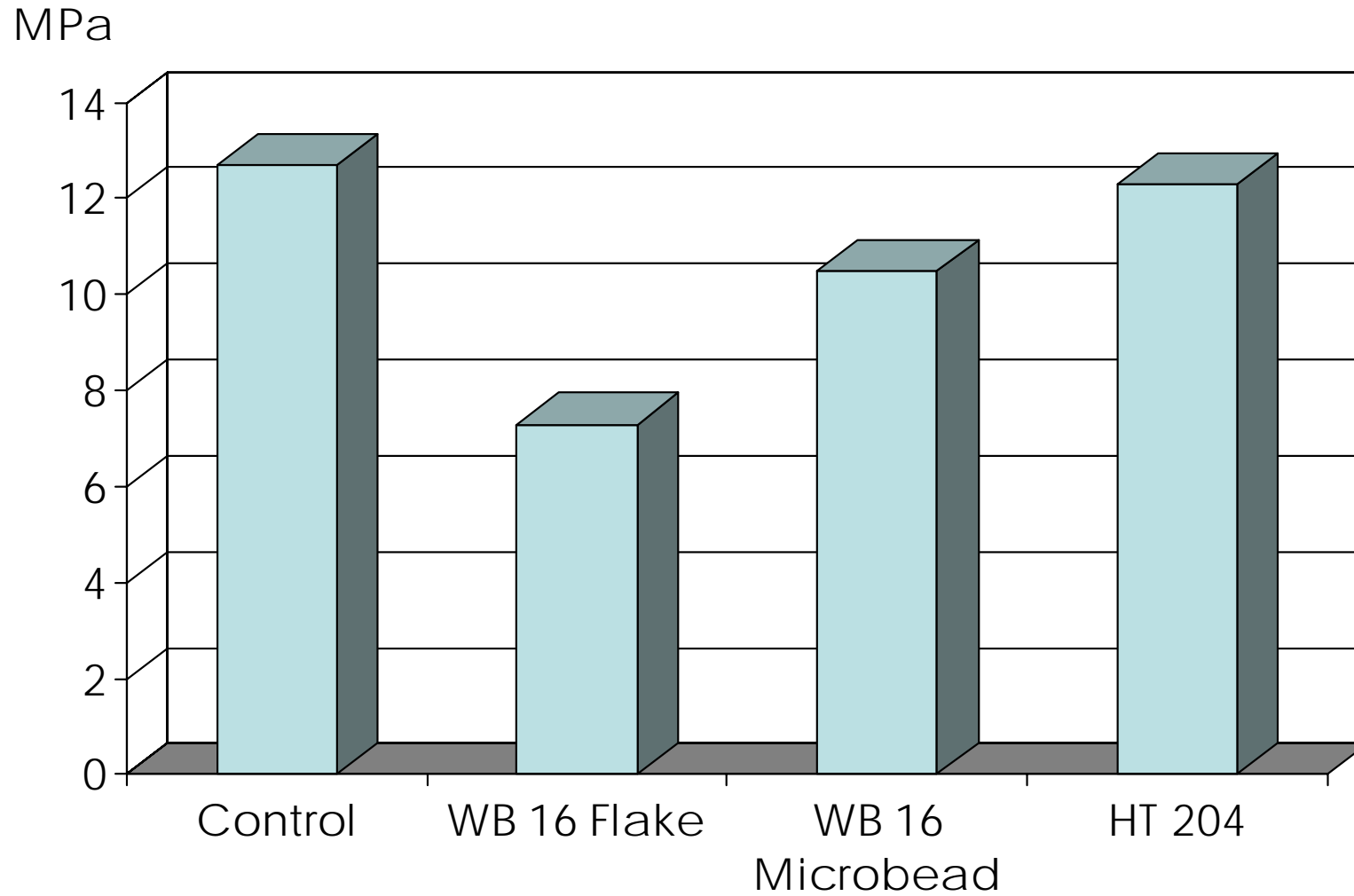
Probably this is due to rotor slippage as undispersed WB 16 melts at 180°C during curing





Microscope images of cut surfaces of vulcanisates

Tensile Strength



Conclusion

In a soft / low temperature mixing compound for injection moulding

- ✓ Struktol WB 16 flake did not disperse
- ✓ Struktol WB 16 microbead was borderline
- ✓ Struktol HT 204 was fully OK

Evaluate the Point Of Addition

Is better performance obtained ?

- Late addition avoids process additive becoming bound to active filler surface
- Increased process additive mobility will result in improved flow and release
- Process additive must disperse OK

Ingredient	Control	HT 204 early	HT 204 late
CR (Type W)	100	100	100
ODPA	2	2	2
AFD	1	1	1
N-220	30	30	30
Silica (VN3)	10	10	10
Struktol KW 400	10	10	10
Struktol Zimag 29/43	8	8	8
Struktol HT 204 (added early)		3	
Struktol HT 204 (added late)			3
DOTG	1	1	1
CBS	1	1	1
Sulphur	0.5	0.5	0.5

Single stage mixing in laboratory Banbury.

HT 204 added early after 30 seconds – together with silica

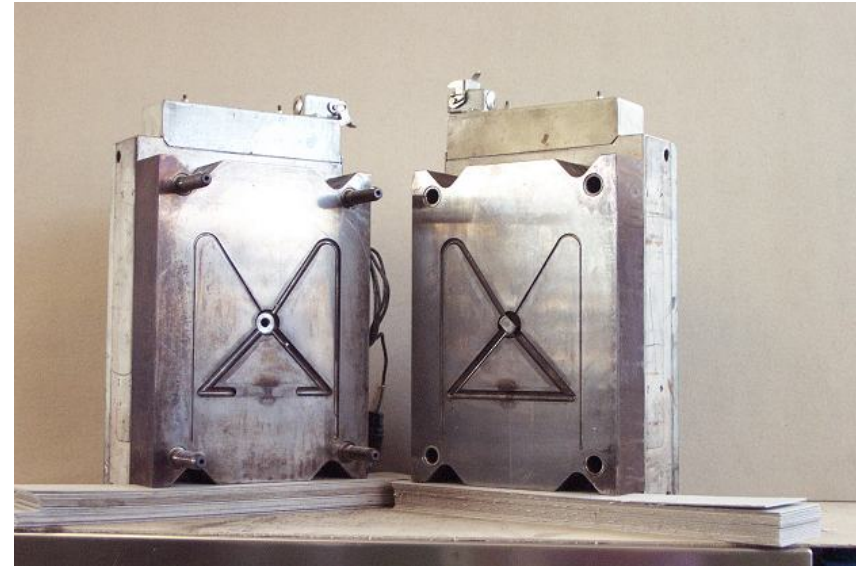
HT 204 added late after 2' 30" - together with curatives

Dump at 3' 30"



Injection Mould Flow Trials

- Use a “Spider Mould”
 - Uninterrupted mould flow
- Measure each moulding weight
 - Plot for each compound



Spider Mouldings



Control



Struktol HT 204
added early



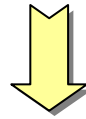
Struktol HT 204
added late

Conclusion

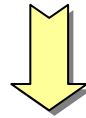
The point of addition has an influence

- ✓ Late addition resulted in increased flow properties for the same loading
- ✓ Struktol HT 204 dispersed OK when added late in mixing

Thank you for your attention



For more info: www.struktol.de



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