A Systematic Approach to Surface Treatment of Mineral Fillers

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Outline

- **Why surface treat fillers?**
- **What is the state-of-the-art?**
- **How can we make improvements?**
- **The system: finding the right treatment type and the optimal dosage**
- **Focussing on just the essential properties**
- **The results**
- **Conclusions**

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Why surface treat fillers?

The main reasons:

- **Improved processability**
- **Improved dispersion**
- **Higher filler loadings are achievable**
- **Improved mechanical properties, especially impact strength**
- **Reduced need for antioxidant**

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What is the state-of-the-art?

- Silanes are effective on silica, stearic acid is good on calcium carbonate
- For other fillers and pigments there are no recognized optimal treatments types
- Often 1 weight % of additive is used, irrespective of the actual amount needed

Surface treatment today is more like a black art than a science!

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How can we make improvements?

We need systematic methods!

- **A method to find the most effective surface treatment for any given filler or pigment**
- **A method to determine the right amount to add**
- **A way to accurately judge the results and work out if the surface treatment gives worthwhile benefits**

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Finding the right treatment type and the optimal dosage level

- **It is possible to systematically select a surface treatment type that is best for any given filler or pigment**
- **Simple, fast, inexpensive rheological tests show which type of treatment adsorbs best**
- **The rheological test detect how well dispersed the filler is**
- **The same test shows which level to use**

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Focussing on just the essential properties

- **Many processing and mechanical properties are effected by surface treating the filler**
- **Very hard to decide whether treatment is beneficial and cost-effective**

In reality, usually only three properties are essential:

- **VMFI (melt flow index modified to be valid for composites)**
- **Modulus**
- **Elastic limit (the true yield stress)**

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The results

For PP filled with calcium carbonate:

- **Materials costs reduced by over 5 %**
- **Increased filler loading from 40 weight % to over 50 weight % with no change in processability**
- **Increased tensile modulus by >35 %**
- **Increased the elastic limit by > 5 %**
- **Improved the oxidative stability**

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Conclusions

- Surface treatment can be very beneficial and cost-effective
- Systematic methods exist for optimizing the treatment type and level
- It is possible to focus on just a few properties to make interpretation easier
- Lower materials costs, better processability and better mechanical properties

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