

How is active Zinc Oxide working ?

Proposal of a mechanism.



Introduction

- BPRI 1999 - W.Jambers - Centexbel.
0,75 phr « active » ZnO gives comparable gelation and vulcanization time as with 4 phr of thermal ZnO.

How is this possible?



Production of ZnO

- 3 production mechanisms :
 - American process
 - French process
 - Wet process



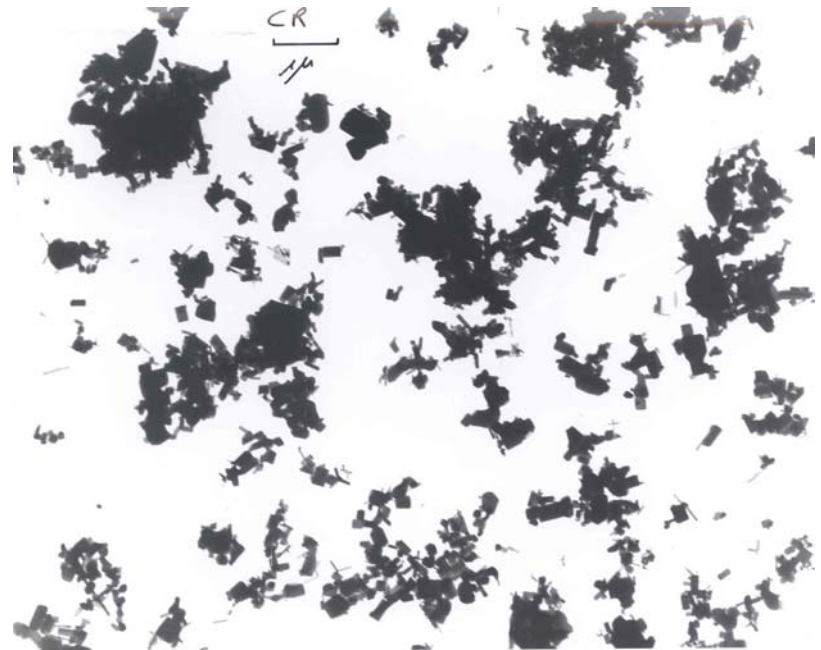
American process

- TEM photo of ZnO showing an acicular structure.
- Production process by ore reduction and oxydation.
- BET : 1-2 m²/gram. controlled by grinding.



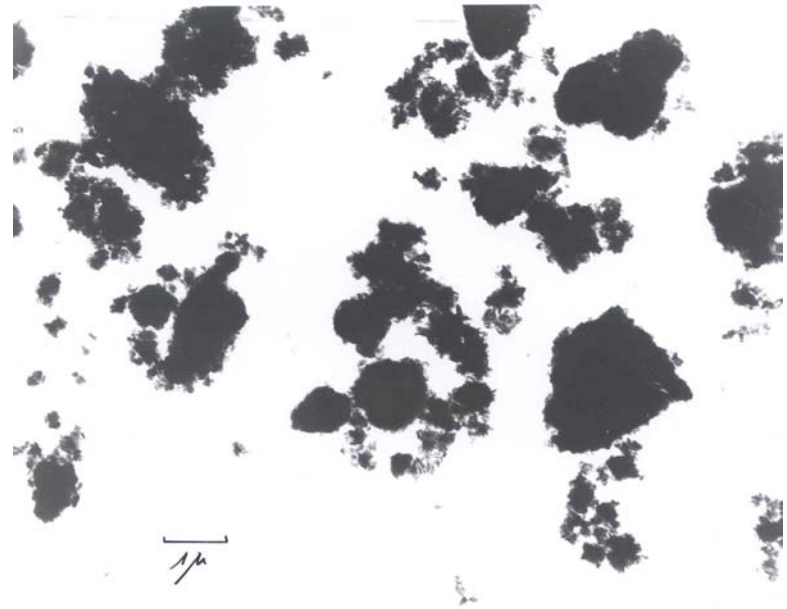
French process

- TEM photo of ZnO showing a nodular and cristalline structure.
- Production obtained by distillation of Zinc metal.
- BET : 4-10 m²/gram controlled by grinding.



Wet process

- TEM photo of ZnO showing a complete nodular structure.
- Processing of zinc dust by chemical reaction.
- BET : 4-75 m²/gram.
By process control.



Impact of Zinc source

- American process = ore = high level of impurities
- French process = zinc metal
 - 2 possibilities :
 - Zinc with low level impurities (pharma grade)
 - Zinc metal from galvanisation, recycled = higher level of impurities.
- Wet process = Zinc dust high purity.

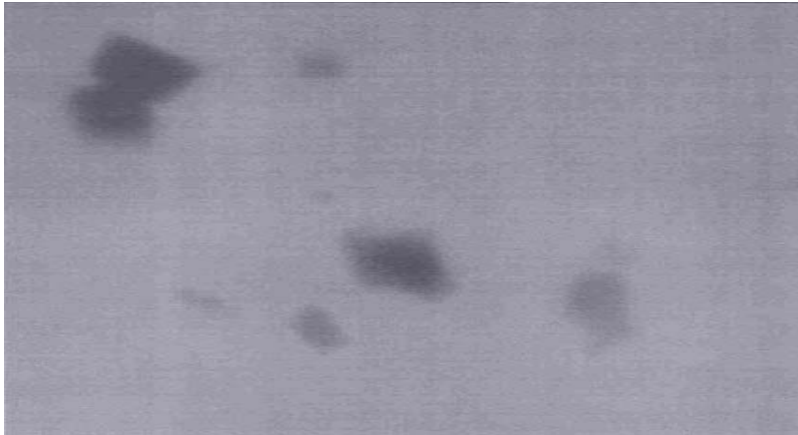


Role of ZnO in latex formulation

- 2 important roles :
 - vulcanisation activator
 - destabilisator : complex formation of ammonium zinc (ZnNH_4)⁺ in the presence of gelifying agents.
 - Remark : Fatty acids are part of the latex and therefore there is no addition of stearic acid required.



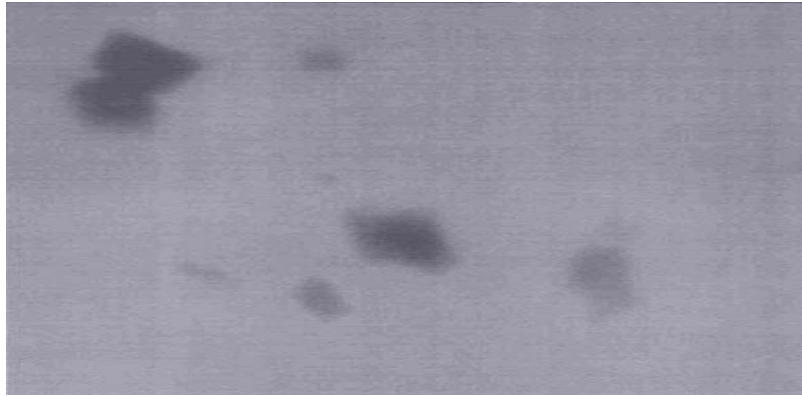
Effect of fatty acid on ZnO



- Tem of french processed ZnO



Effect of fatty acid on ZnO



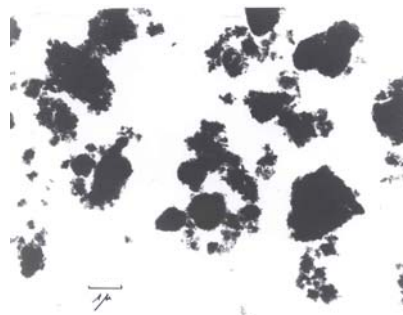
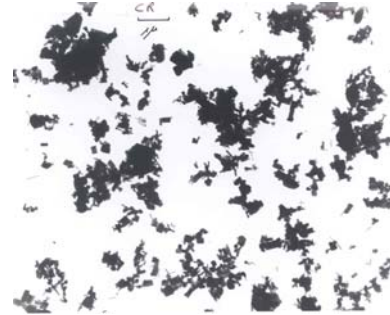
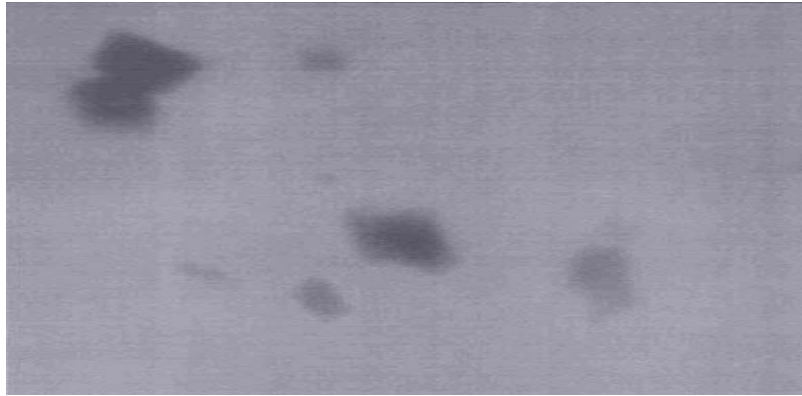
- French processed ZnO



- Wet processed Active ZnO

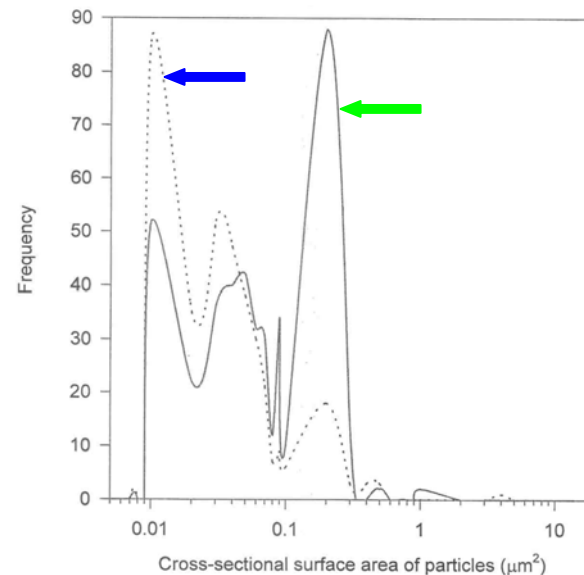


Effect of fatty acid on ZnO



Action of fatty acid on ZnO.

- French processed ZnO shows more bigger particles above $0.1\mu\text{m}^2$.
- Wet processed ZnO improves the amount of small particles.

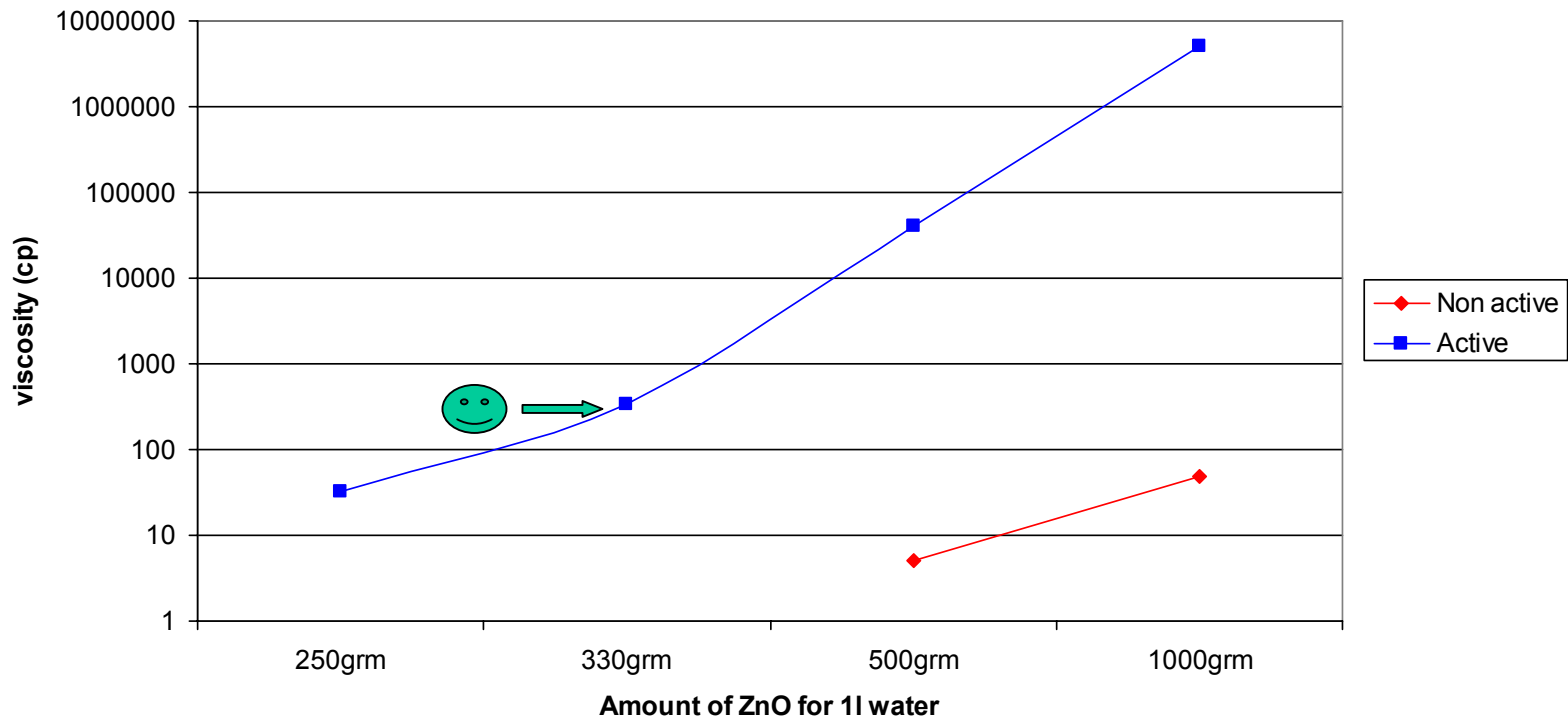


Problems due to ZnO active

- For a vulcanising dispersion of 30% or more, there is gelification of this dispersion.
- Solution : decrease amount of ZnO « active » in the vulcanising dispersion to avoid the formation of a gel. This will have no impact on the final vulcanisation level as the « active » ZnO reacts completely.



Viscosity versus conc. ZnO



Advantages of ZnO « active »

- Low heavy metals (wet process)
- Less ZnO consumption (active material)
- Ecologically friendly (less Zn rejects)



Conclusion

- The proposed mechanism of « active » ZnO shows why it is possible to reduce the amount of ZnO in a latex formulation.
- Consequently « active » ZnO is a good ecological and economical way to improve performance of latex formulations.

