Super PVC

A Concept for the Future

Dr. Yatish B. Vasudeo

BY INNOVATIONS Consultancy

i-PVC Conference

18th October 2012

Introduction

PVC is a mature polymer and still being used in wide variety of applications. These materials have been surpassed by olefinic polymers. However, they have maintained their place and serving human race even today. Their history goes back to 1930 & 1940s

PVC

PVC today is called as polymer for infrastructure and finds maximum usage in Pipes, Profiles and cables.

The most popular method of manufacturing PVC is by suspension polymerization

Polyolefins

- Metallocene based catalyst technology has revolutionized polyolefin Industry. It is considered as single most important development in catalyst technology since the discovery of Ziegler-Natta Catalysts.

- The frenzy of activity in this area is due to metallocene catalysts, which offer some significant process advantages and produce polymers with very favorable properties.

PVC Today

- There have been lot of process improvements in the polymerization of PVC.
- There have been productivity gains in both manufacturing processes. However, there have been no radical or game changing developments like in the case of polyolefins.
- The resultant has been polymers with same or similar properties for decades.

Super PVC

- The change is now seen at the horizon and may be that we will have “Super PVC” in the near future. What will bring this change? Will it be the process improvement?
- The Change will be by additivation during polymerization / processing..

Nanotechnology

has the answer

Nano Size

- 1000 mm = 1 Meter
- 1000 microns = 1 mm
- 1000 nanometers = 1 micron (Smaller than wavelength of light)
- At nano size, the known minerals behaves differently to what we are used to. At single digit loadings host of properties are achieved in **NANOCOMPOSITES**

The Nano Effect

In tiny sizes materials behave in different ways.

They are sometimes

- Stronger
- Conduct more electricity
- Opaque substances become transparent
- Solids become liquids at room temperature
- Insulators become conductors

Surface area of nano particles is larger than compared to its volume.

PVC & Nano Minerals

- Enhanced Rigidity – Stiffness & Toughness
- Enhanced Thermal Properties – HDT
- Transparent Rigid & Flexible Compounds
- Reduced dosage of impact modifiers
- Improved Flame Retardancy & Smoke Toxicity

Suggested Minerals

1. Calcium Cabonate
2. ATH
3. Silica
4. Hydrotalcite
5. Nano Clays

Nano Particle Additive

- Compounding Additive
- In-situ Polymerization Additive

Nano Minerals & Surface Area

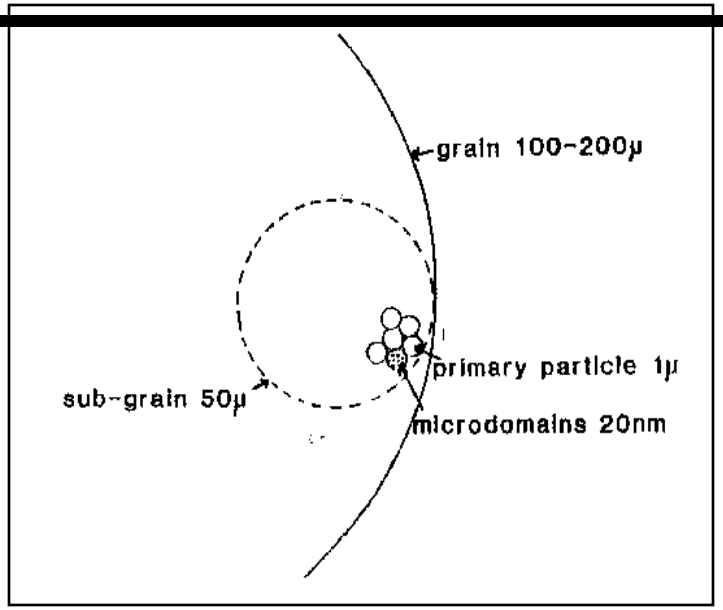
- Minerals used by PVC industry are having BET Surface Area of maxi 1- 5 m2/gm.
- Most Nano minerals have BET Surface Area of > 50 m2 /gm.
- Higher Surface Area minerals are difficult to disperse in conventional processing equipment available with the processing industry.
- The best solution is to add them during Polymerisation.

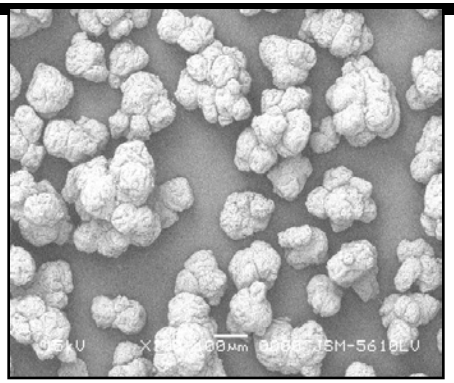
New Developments in PVC Polymerisation

1. Use of Nano Minerals during Polymerisation for better dispersion of Nano Minerals

2. Non Aqueous Route of PVC Polymerisation

Morphology of PVC Grains

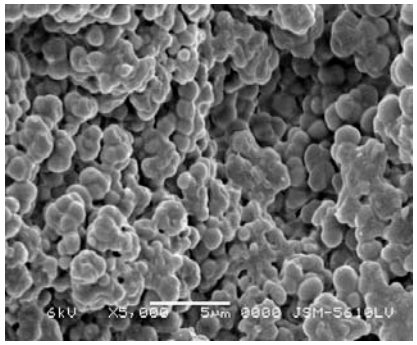




PVC Grains

CH2 CH2 CH2 CH2
/ \ / \ / \ / \
CH CH CH CH
/ / / /
Cl Cl Cl Cl

8 Carbons in PVC = 1 nano meter 10^{-9}



PVC Primary Particles

Nano Fillers in PVC Polymerisation
US Patent filed in 2007

Addition of Nano fillers in PVC has been very successful as seen from following claims made in the patent

	PVC/nano Filler	Only PVC
Formulation		
PVC	100phr	100phr
One pack Stab.	6phr	6phr
MBS	3phr	6.5phr
Properties		
Charpy Impact	88kg.cm/cm	30
Izod Impact	114kg.cm/cm	15

Blue Ocean Strategy

How to create Uncontested Market Space and Make the Competitor Irrelevant.

By

W. Chan Kim & Renee Mauborgne

Harvard Business School Press, 2005

Dr Yatish B. Vasudeo

Innovation Consultant

33, Sant Namdeo Krupa,
12, Harishchandra Goregaokar Road.
Gamdevi. Mumbai 400 007
Tel. 91 22 32940433, Cell: 91 93222 15380,
e-mail: yatish@drvasudeo.com
URL: www.byinnovationsconsultancy.in

Thank You