CYLATEC

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CylaCell® - *PA*

Dispersing and Processing Aid for Color Concentrate Compounding

CylaCell dispersing and processing aid allows the commercial production of improved color and additive concentrates by increasing the wetting-out of color, filler, FR and other additives by the resin in the concentrate. By increasing both wetting and dispersion, concentrates compounded with ***CylaCell*** offer better let down and more uniform finished parts. Utilization of color pigment is also improved due to better pigment dispersion, and can result in lower required pigment loadings to achieve any given finished part color. A ***CylaCell*** level of 0.25 to 0.40% is generally recommended to produce the desired results. (See Formulating Guidelines, p. 4)

CylaCell also eliminates the environmental problems sometimes associated with other dispersing and processing aids. It is totally inorganic, odorless and safe for both people and equipment.

The apparent color of a finished part is directly related to the surface area and dispersion of the color pigment in the resin. For any given pigment loading, the color of a part as seen by an observer relates directly to the number of visible pigment particles and their distribution within the resin, rather than the total pigment loading. Increasing the pigment loading while simultaneously increasing the apparent pigment particle size will not result in an increase in color intensity. Conversely, decreasing the apparent pigment particle size will allow a lower pigment loading while still maintaining a desired color.

The nature of color pigment particles is such that they tend to agglomerate into larger particles with a lower apparent surface area. Thus the achieved pigment surface area in a resin melt is usually significantly lower than its intrinsic or potential surface area.

The object of the compounding operation is to break up pigment agglomerates, and to wet out and disperse these particles within a resin melt. The degree of break up and dispersion achieved during this process determines the achieved surface area and the utilization value of the pigment being used. (Fig. 1)

Fig. 1 - Apparent Surface Area vs. Degree of Agglomeration

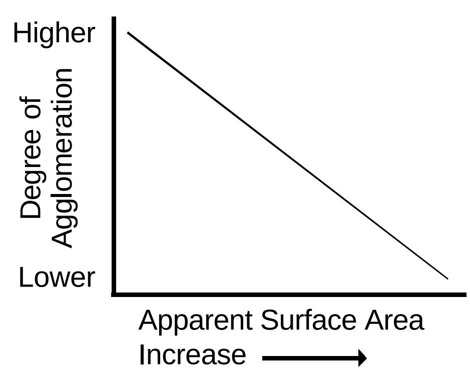

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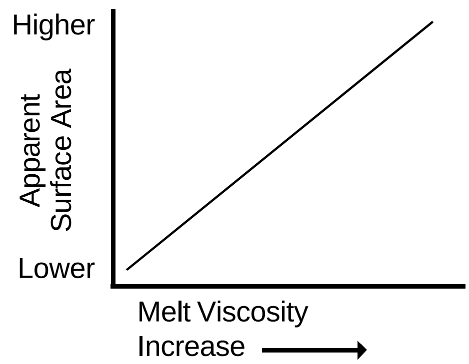
Fig. 2 - Melt Viscosity vs. Apparent Surface Area



As pigment agglomerations are broken up and the individual particles wetted out with resin, the apparent surface area and utilization value of the pigment increases. For many color concentrate formulations, increased dispersion with a resultant surface area increase can result in a melt viscosity increase with a resultant decrease in the Melt Flow Index of the concentrate. (Fig. 2)

This phenomenon can be explained with the following analogy: A cup of pebbles added to a cup of water will result in a pourable mixture. Grinding the pebbles into sand and mixing it with the same amount of water will result in a thicker mixture. Further grinding of the sand into a sub-micron powder and then adding it to the same cup of water will result in a stiff, non-pourable paste. Thus, as pigment agglomerations are more efficiently broken up and wetted out in the compounding operation, Melt Flow Index of the concentrate may tend to decrease.

In many cases, the addition of the minimum effective amount of ***CylaCell*** processing and dispersing aid in concentrate compounding will result in a lower Melt Flow Index for the above reasons, and is a direct result of better pigment dispersion, higher achieved pigment surface area, and a higher pigment utilization value. The higher pigment utilization value will often allow a lower pigment loading in the concentrate to achieve the same finished part color. **When compounding FR concentrates, better dispersion can increase the effectiveness of the FR additives in the system, resulting in better ratings with the same loading of FR additive, or the same ratings with a lower loading of additive.**

In many cases, the use of ***CylaCell*** *can improve finished part physicals. Further improvements can be achieved when wax dispersants, which tend to degrade physicals, are removed from the compound. Elimination of wax also eliminates the associated problems of wax agglomerations.*

Additional amounts of ***CylaCell*** over and above the minimum required for dispersion may cause an increase in the Melt Flow Index for reasons stated below:

Once dispersion and higher apparent surface area is achieved, the effect of additional amounts of ***CylaCell*** relates to the Critical Pigment Volume Concentration (CPVC) of the system. The CPVC can be defined for any liquid/solid system as the point at which the liquid fraction (in this case the melted resin) is present in just sufficient quantity to completely wet out and entrain the solid fraction (filler) in one continuous phase. Any filler added after the CPVC is reached will result in unwetted or partially wetted filler particles, forming a discontinuous phase and poor dispersion. In the thermoplastic extruding and compounding process, additive levels approaching the CPVC will cause higher pressure, higher torque requirements, surging, poor mixing and variation in finished compound physicals.

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CylaCell dispersing and processing aid works by changing the CPVC value of the system. Through coupling, dispersing and compatibilizing actions, ***CylaCell*** drastically shifts the CPVC forward. *Its effect is most apparent at filler/additive levels approaching the CPVC which are normally difficult to handle.* (Fig. 3)

Effect of CPVC on Processability of Resin & Filler/Additive Mixtures

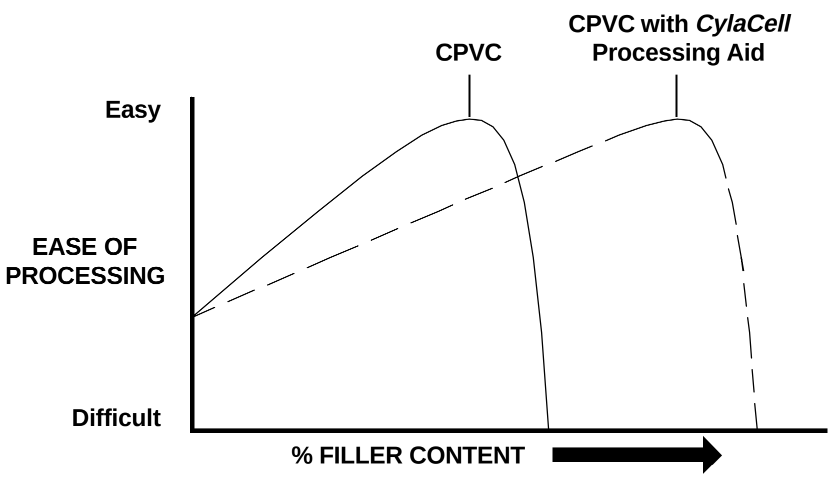

Fig. 3

The CPVC is dependent upon resin and additive characteristics, and will be markedly different for particular resin/additive combinations. Additive particle size and shape (and thus surface area), as well as surface compatibility with the resin, will have a large effect on the CPVC, as will the viscosity of the resin at processing temperatures. The CPVC for different resin and filler/additive blends can be as low as 2% filler/additive for some combinations, or as high as 80% filler/additive for others.

As filler/additive levels and their apparent surface areas are increased in any resin, and as the CPVC is being approached, significantly higher die pressures, higher drive amperage and possibly extruder surging will be evident. Incremental additions of ***CylaCell*** processing aid at this point can lower extruder torque and pressures, and allow the addition of higher levels of filler/additives if desired.

Finished films, sheets, extrusions or injection molded parts produced by letting down or diluting a high filler compound can be adversely affected if the filler in the high filler compound is not completely wetted. Since most production extruders do not have the mixing capability of a compounding extruder, nonwetted filler particles in the high filler compound can pass through the production extruder and wind up in finished parts, sheets or film. Using ***CylaCell*** processing aid in the initial high filler compounding step will help insure a homogeneous let down in production equipment, thereby reducing scrap and improving uniformity in finished part physicals. This improved uniformity is usually evidenced by lower standard deviations in some of the physical test values. **Using *CylaCell* in the let down process as well can result in better parts, fewer rejects, lower pressures and improved cycle times.**

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CylaCell processing aid has been proven to decrease the effort required by equipment to extrude filled thermoplastic resins and concentrates. With ***CylaCell*** added to a highly filled resin, die pressure and current draw consistently go down.(see Figs. 4-5) **This yields higher production rates and lower operating temperatures.**

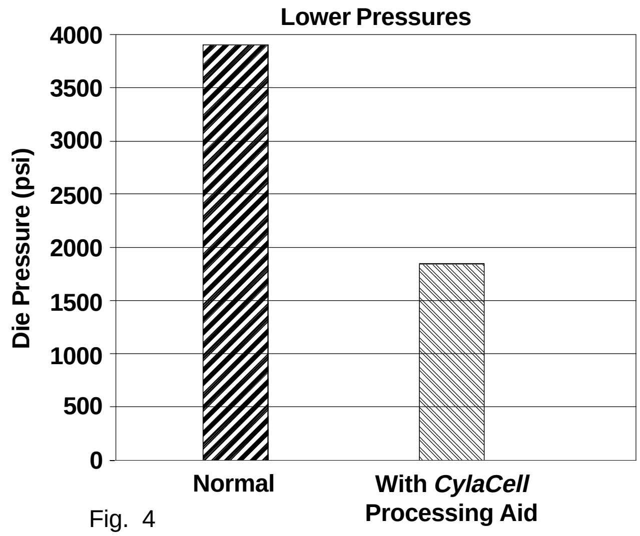

Fig. 4

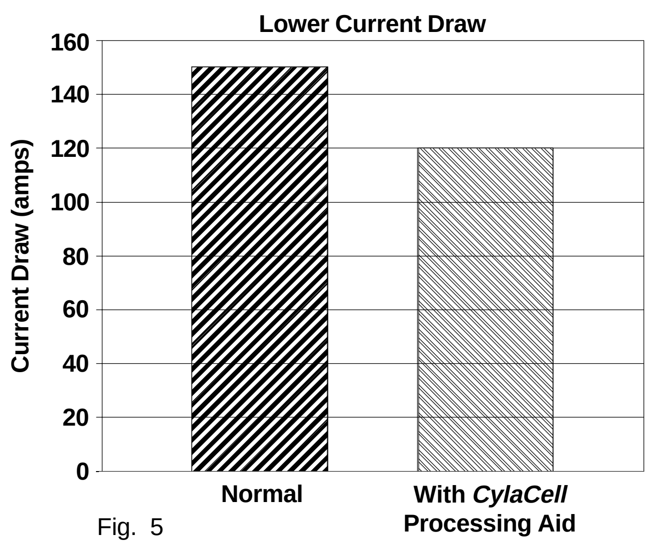

Fig. 5

FORMULATING GUIDELINES:

1.) ***CylaCell*** requires both heat and pressure to perform its intended function. If preblending operations subject ***CylaCell*** to temperatures greater than about 180°F (82°C), we recommend that ***CylaCell*** be added directly to the downstream compounding screw. By subjecting ***CylaCell*** to temperatures over 180°F without pressure, it may be deactivated and fail to perform in the subsequent screw operation.

For this same reason, performance testing in non-pressurized, heated kneading equipment such as a Brabender may yield erroneous results, since the required pressures will not be achieved.

2.) A starting point of 0.25% ***CylaCell*** is recommended. As dispersion and resultant filler or pigment surface area increase, a decrease in the Melt Flow Index may be seen. Additional incremental amounts of ***CylaCell*** at this point may result in a subsequent increase in Melt Flow as the CPVC of the system is shifted.

An evaluation sample of ***CylaCell - PA*** dispersing and processing aid is available upon request.

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Field Trial Assessment of *CylaCell*® *- PA* Dispersing and Processing Aid

Field Trial #1

Equipment: Twin 90 mm, co-rotating extruder with side feeder additive screws (2) and auxilliary hopper for virgin resin to maintain correct ratios. Computer controlled weigh hopper system. Compunding rate of 1100-1200 lb./hr.

Product: PP/70.50% Omya Carb FT Filler

Amp Draw: Normal - 100 amps @ 1100 lb./hr.
120 amps @ 1200 lb./hr.

With 0.25% ***CylaCell*** added to compound:
100 amps @ 1100 lb./hr.
100 amps @ 1200 lb./hr.

Note: Could not run above 1200 lb./hr. because of side feeder limitations and saw no amp increase from 1100-1200 lb./hr. with ***CylaCell***.

Melt Flow: 4 gram/min. without ***CylaCell***
11 gram/min. with ***CylaCell***

Press Test: Compounded pellets hot pressed between clear mylar sheets (4"x4") at 10,000 PSI.

Without ***CylaCell***: Pressed sample was flat white in color, gritty texture, mottled/marbled appearance.

With ***CylaCell***: Pressed sample was glossy white, smooth texture, no mottled/marbled look. Very uniform.

Summary: Compounder feels rate should increase to 1300-1500 lb./hr. once side feeder problem is corrected.

Substantial increase in melt flow and press test appearance. Other physical properties to follow. Compounder feels all physicals will increase.

Field Trial #2

Equipment: Twin screw extruder (2-2.5"). Capacity: 400-500 lb./hr.

Product: PP/50% Ca Carb Filler (Homopolymer)

Physicals: Notched Izod - 0.90 without ***CylaCell***
1.02 with ***CylaCell*** added at 0.25% level during compounding

Tensile Strenght - 3140 PSI without ***CylaCell***
4951 with ***CylaCell***

Amp Draw: 23% reduction with ***CylaCell***

Melt Flow: No Difference

Field Trial #3

Product: PP/40% Talc Filled (Monopolymer)

With 0.20% ***CylaCell*** added to the compound, the following results were obtained:

Izod Impact increased by 50%
Melt Flow incresed by 15%
Flow Tab increased by 12%-15%
Extruder amp draw dropped by 5%

Field Trial #4

Product: PP/50% Talc Filled

	Control No ***CylaCell***	0.20% ***CylaCell***
Ash content via burn off, %	49.40	47.60
Melt Flow (230°C/2160gm), gm/10 min.	9.66	12.40
Tensile Strength, psi	4400	4900
Elongation @ break, %	2.65	3.21
Izod impact, ft-lb/in	0.38	0.44
Specific Gravity	1.37	1.33

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