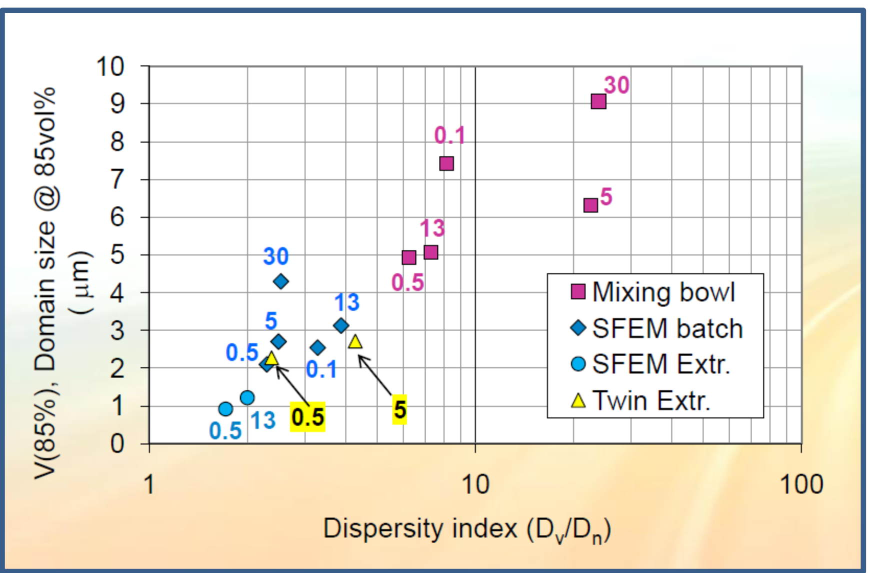
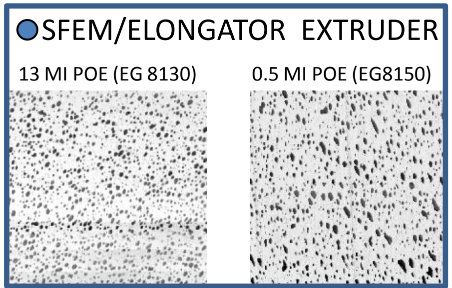
RANDCASTLE EXTRUSION SYSTEMS, INC.

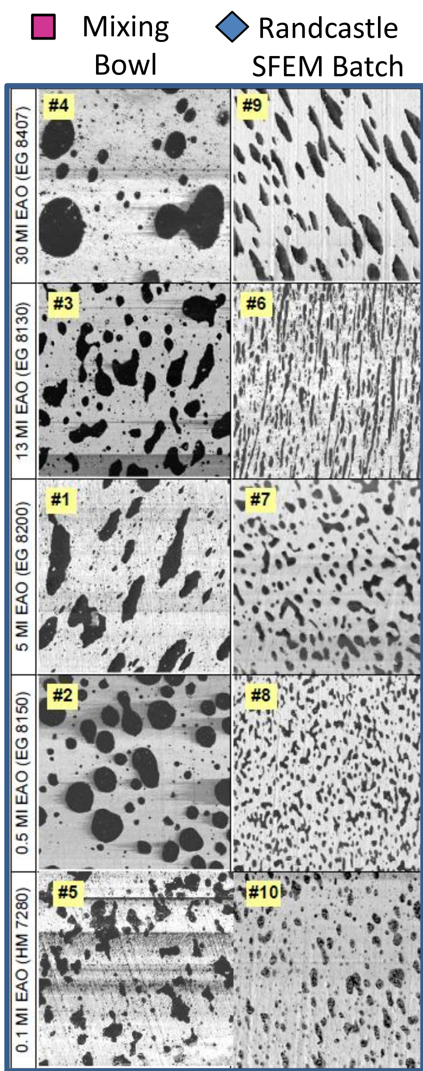
SFEM ELONGATOR SCREWS:

- Dispersity 8 times better than twin screw.
- Dispersity 100 times better than mixing bowl.
- Dispersity 1,000 times better than other single screws.
- Scales to production screws.
- Better homogeneity than a twin.
- Stable pressure (compared to twin).
- High pressure capability (compared to twin).
- High output RPVC powder or pellets (up to 180 rpm!)
- Numerous technical papers available.

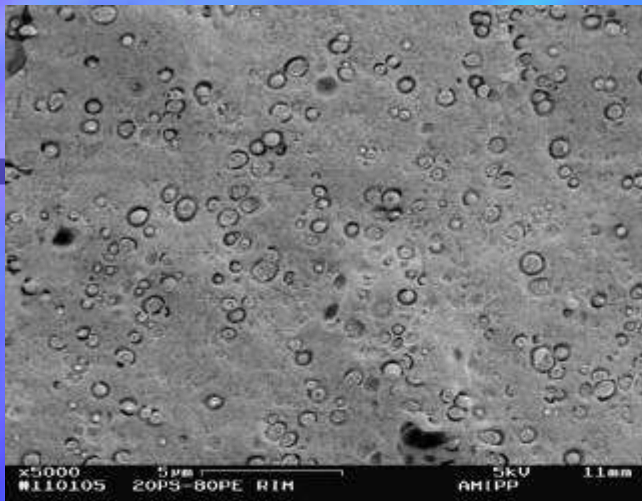


Stéphane Costeux , Dow Chemical
Mark Barger, Dow Chemical, et al
FACILE TPO DISPERSION USING EXTENSIONAL MIXING
Antec 2011 (left and right)

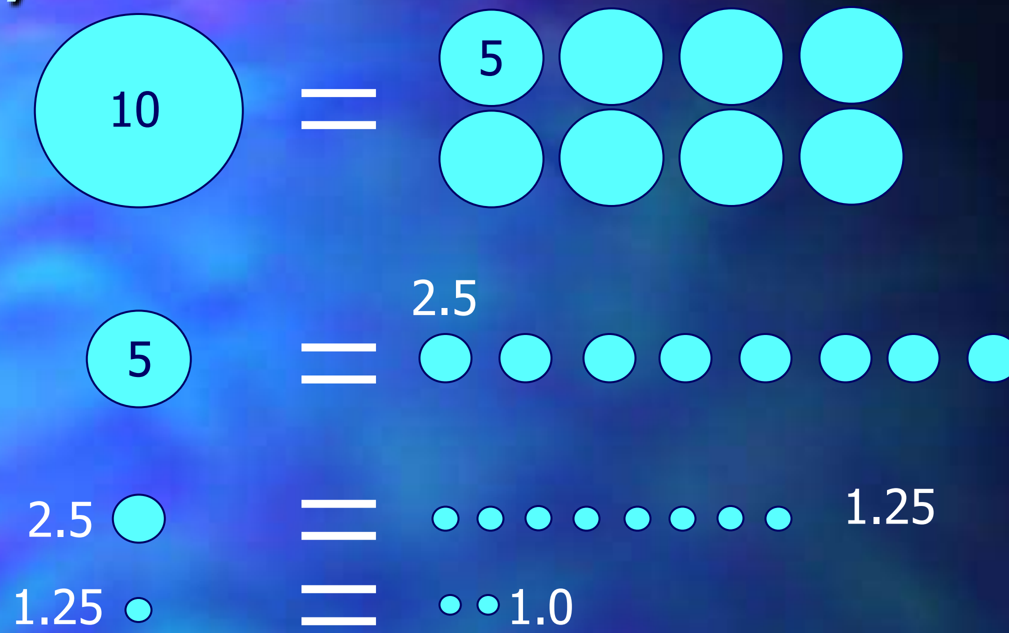




Mixing 1,000 Times Better



This picture shows minor phase domains of 1 micron from our AFEM mixing screw.



Conventional single screws are known to make domains of about 10 microns.* Our screws make 1 micron. How much better is that? Micro-photographs show two dimensional domains that are really three dimensional spheroids. Every time you halve the diameter, you reduce the volume 8 times. So, if have a 10 micron sphere, you need eight 5 micron spheres to contain the same amount of material. Likewise, you need eight 2.5 micron spheres to have the same volume as a 5 micron sphere. So, you need 8 x 8 x 8 x 2 = 1,024 spheres of 1 micron to equal the volume of a 10 micron sphere. *Our AFEM and SFEM screws are 1,000 times better.*

**See Summary Results of A Novel Single Screw Compounder, Antec -07 www.randcastle.com under technical papers.*

Study May Boost Prospects For Single-Screw 'Elongator'

Has the heated debate over whether a single screw can possibly provide elongational mixing akin to a twin screw now been settled?

Dow Chemical Co., Midland, Mich., weighed in at last year's SPE ANTEC (May 1-5 in Boston) with a paper discussing results of experiments it conducted on a novel elongational mixing device developed by Randcastle Extrusion Systems, Cedar Grove, N.J.

The paper, delivered by Dow researcher Stephane Costeux, discussed the results of mixing tests using Randcastle's SFEM series batch mixers versus a batch-mixing bowl, both running TPO blends of 70% polypropylene and 30% ethylene copolymers. The batch mixer had the same basic geometry as Randcastle's SFEM patented elongational mixer for single screws, introduced in 2008.

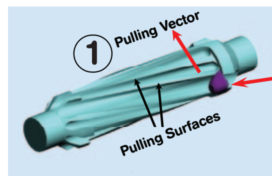
Dow's testing confirmed that where typical batch mixers are shear-dominant, the Randcastle mixer has "stronger extensional flow" to achieve better TPO dispersion. The Dow study also used a Randcastle single-screw extruder with similar mixing geometry to determine that the "SFEM's primary deformation mode is elongational (as opposed to shear-dominated)," and added that "a single-screw extruder equipped with SFEM mixing elements achieved even finer dispersion, usually achievable only with twin-screw extruders."

Keith Luker, president of Randcastle (***randcastle.com***), has been touting the elongational mixing capabilities of his device since he first developed it. The response, by and large, has been skeptical, as twin-screw extruders are generally considered the gold standard where mixing is concerned.

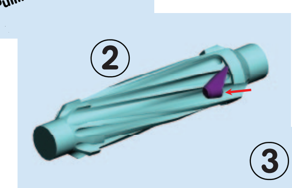
"Elongation is a stretching force; its opposite is compression," explains Luker. "Compression pushes material together, as in the compression section of a screw. If you take a cylinder and push on it from all sides nothing will happen. Take the same volume of a cylinder and stretch it out into a film, and you get an exponential increase in surface area. That quantifies the mixing improvement. The key is the pulling surface that stretches material from the inlet channel—just as nip rolls pull." (See illustration of how it works.)

The Dow paper also addressed the matter of scale-up: "The most important attribute of mixing equipment used to make such small-scale blends is that it achieves a degree of mixing or morphology that is consistent with that obtained with large-scale compounding equipment. If the geometry of the batch mixer is very different from the mixing-element geometry of the large-scale process (often involving a single-screw extruder), translation of laboratory formulation results to commercial scale becomes extremely challenging."

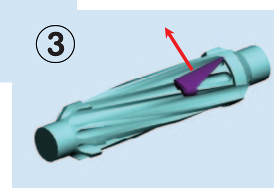
HOW THE ELONGATIONAL MIXER WORKS



A cylindrical concentration of unmixed material (purple) enters the first channel pushed along by pressure flow by upstream flights. It is immediately grabbed by the moving pulling surface-just as pull rolls would grab your finger.



Pressure flow pushes the material along the inlet while pulling surface and drag flow begin to convert the cylinder into a film.



The concentration nears total conversion to film. The actual film is much longer than depicted because the drag velocity is much higher than that inlet channel velocity.

But Luker notes that the batch and screw SFEM mixers have essentially the same geometry. "You expect the same geometry to scale up," states Luker. "You do not expect mixing-bowl geometry to scale up to because it does not resemble a single screw."

Luker notes that a previous paper delivered at ANTEC 2008 by Drs. Jennifer Lynch and Tom Nosker of the Dept. of Ceramic and Materials Engineering, Rutgers University, New Bruswick, N.J. confirmed the scale-up from batch mixer to extruder screw.

Commercial applications of Luker's SFEM elongational mixer to date include mixing of 35% calcium carbonate in a direct-extrusion application; mixing immiscible materials for pipe; mixing large mica flakes for pearlescent compounds; and blending high- and low-viscosity polymers.

Luker says it takes only two mixing sections in a 24:1 LD screw to get about 125 times better mixing, or three mixers in a 32:1 LD to give you about 1000 times better mixing, than with a standard single screw. PT

By James J. Callari, Editorial Director