

## Flexidone™ FE Specialty Plasticizers for PVC Applications

Enhanced performance and processing  
efficiency for flexible PVC products

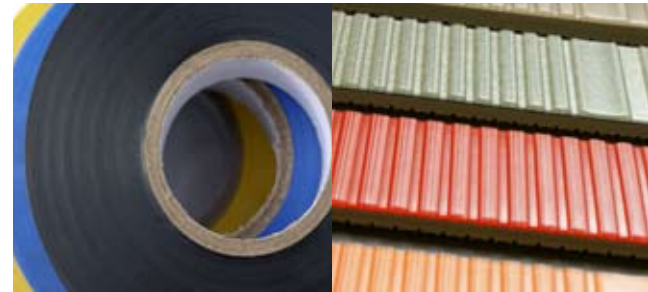
Flexidone FE is a new range of PVC plasticizers containing ISP alkyl pyrrolidone technology. Versatile in usage, Flexidone FE can serve as a primary plasticizer or used in conjunction with other primary and secondary plasticizers to achieve greater cost savings while maintaining or improving performance. Processing temperatures can be remarkably lower with Flexidone FE, enabling use of a variety of manufacturing methods and a reduction in energy consumption.

Featuring fast gelling, one of the products in the line, Flexidone 350FE, is an excellent plasticizer for many applications. Flexidone FE can be tailored to increase tensile strength and elongation at break, transparency and cold flexibility. As an alternative to phthalate technology as well as to other non-phthalate products, Flexidone FE is available in different grades such as Flexidone 350 and 550. By optimizing the formulation, performance profiles and costs can be modified to meet your specific requirements.

Two key advantages of this system are its versatility and flexibility. Flexidone FE yields stable, low-viscosity plastisol with excellent shelf life and desirable fast-fusing properties. This combination enables the system to be used in various production methods such as extrusion, calendaring and injection molding. And with a cost advantage over other alternative plasticizer systems, Flexidone FE represents a breakthrough value to the manufacturers of flexible PVC items.

### Benefits

- Cost effective formulations
- Robust/Forgiving processing
- Time and energy saving
- Can be used in challenging conditions
- Green and Environmentally friendly products



### Benefits

- Highest plasticizer efficiency
- Fast and homogenous gelling
- Can be tailored to alter economics, performance
- Can be processed using various methods
- Good hydrolytic stability, high compatibility
- Low processing temperature
- Excellent cold flexibility
- Higher filler loads or using less compatible materials possible
- Non-phthalate

# Flexidone™ FE Specialty Plasticizers for PVC Applications

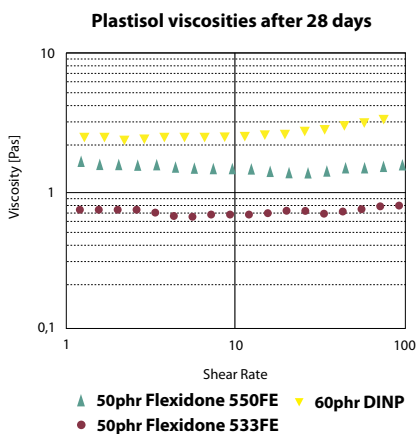
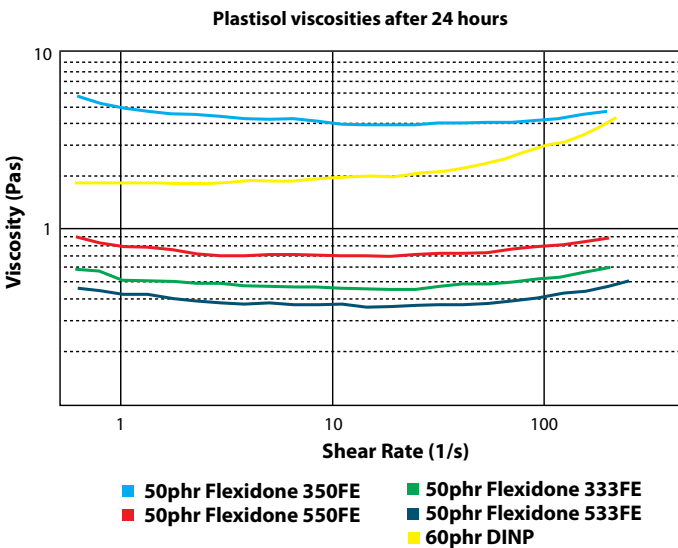
Enhanced performance and processing efficiency for flexible PVC products

## Physical properties

Appearance	Pale yellow liquid
Odor	Characteristic
Specific gravity	0.86 – 0.92 @ 25°C
Solidification point	<0°C
Viscosity	~30 Cps

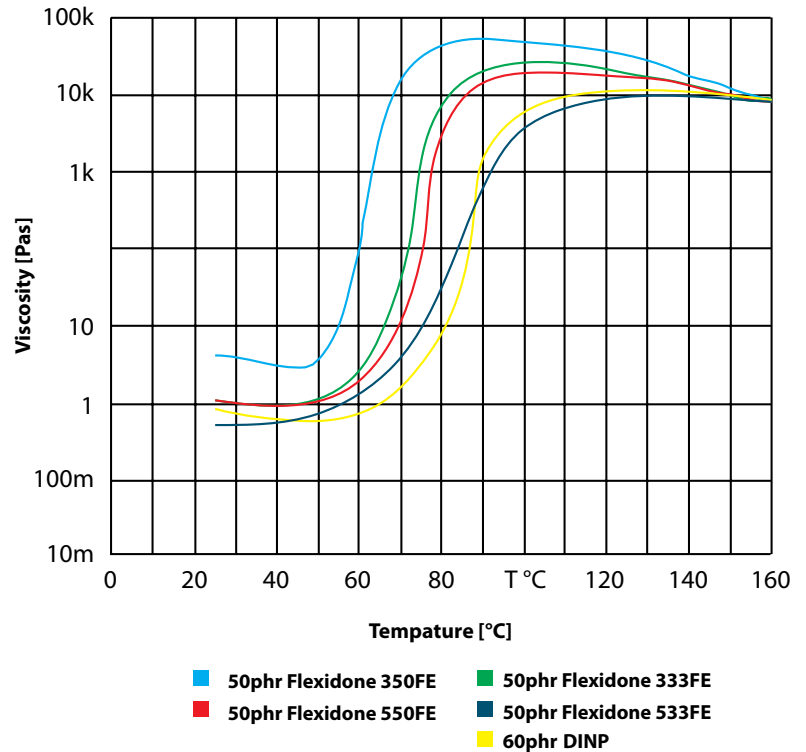
As a high-efficiency plasticizer, Flexidone 350FE has as much as a 30% advantage over other commonly used plasticizers. The Flexidone FE series of plasticizers provide low-viscosity plastisols with good gelling properties. As figure 1 indicates, of various samples of plastisol formulations, those with Flexidone 333FE and 533FE exhibited the best viscosity stability after 28 days, enlarging the processing window for many product manufacturers.

Figure 1: Viscosity of various plastisol formulations with Flexidone grades compared with DINP



In addition to better viscosity stability, Flexidone FE improves the gelling behavior of PVC products, which affects its strength. In figure 2, the gelling rates of Flexidone 333FE and 350FE were the fastest compared with other Flexidone grades and a DINP.

Figure 2: Gelling curve of Flexidone FE grades and DINP

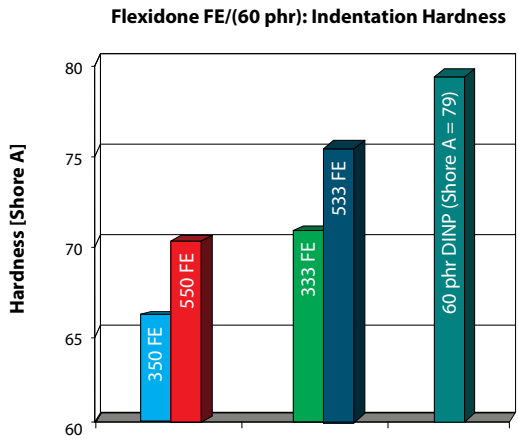


Flexidone FE is available in four standard grades and customized formulations. All can serve as primary plasticizers, especially for PVCs that require very good cold flexible properties. Standard grades are:

- **Flexidone 350FE:** offers fast and low-temperature gelling, improved transparency and homogeneity. As a primary plasticizer for plastisols (for immediate processing), it is an extremely fast fusing system requiring about 30% less use than standard plasticizers.
- **Flexidone 333FE:** can be used as primary plasticizer; about 15% more efficient than other systems; has lower plastisol viscosity than 350FE and stays stable even after longer storage.
- **Flexidone 550FE:** can be used as primary plasticizer with gelling properties similar to 333FE but at a lower viscosity with higher clarity and lower volatility.
- **Flexidone 533FE:** for very-low-viscosity plastisols; can also be stored for very long time. Lower volatile.

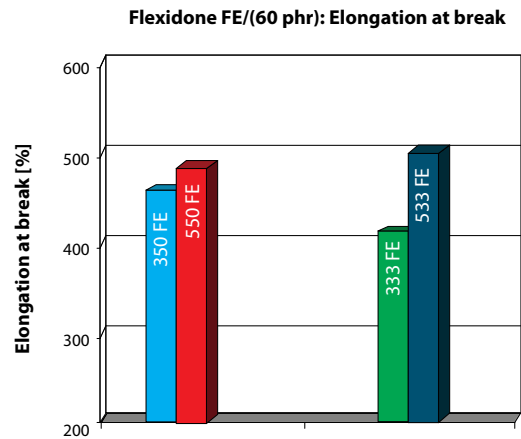
Flexidone FE grades offer manufacturers great flexibility in PVC processing, excellent value and the ability to customize benefits. Against competing technologies, they offer clear performance and economic advantages at a highly compelling price.

Figure 3: Efficiency of the Flexidone FE types



All standard Flexidone FE types are significantly more efficient than DINP

Figure 5: Mechanical properties of the Flexidone FE types



Flexidone shows very interesting rubber like behavior with elongation at break for more than 450%

Figure 4: Mechanical properties of the Flexidone FE types

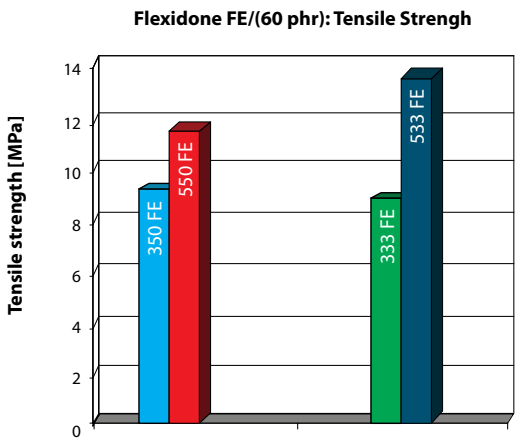
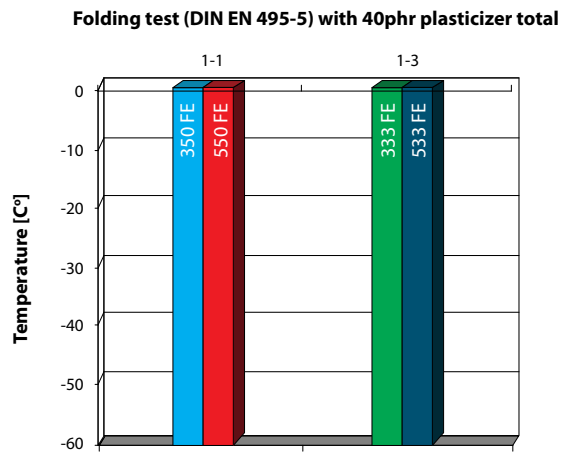


Figure 6: Failure temperatures of PVC plasticized with Flexidone FE types



With 40 phr and 60 phr plasticizer total here were no failures at all at -60°C

Flexidone FE plasticizer systems are synergistic also in terms of cold flexibility!

**For more information, contact us at [plastics@ispcorp.com](mailto:plastics@ispcorp.com)**

**To find an ISP sales office in your country visit: [ispcorp.com](http://ispcorp.com)**

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Flexidone is a trademark of ISP. Product Code: PCH5968-10/2010

The use of alkyl pyrrolidones as plasticizers for PVC is covered in ISP's US Patent 7,411,012. Currently, ISP is working on a new patent application that covers the use of the combination of alkyl pyrrolidones and fatty esters as plasticizers for PVC.

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