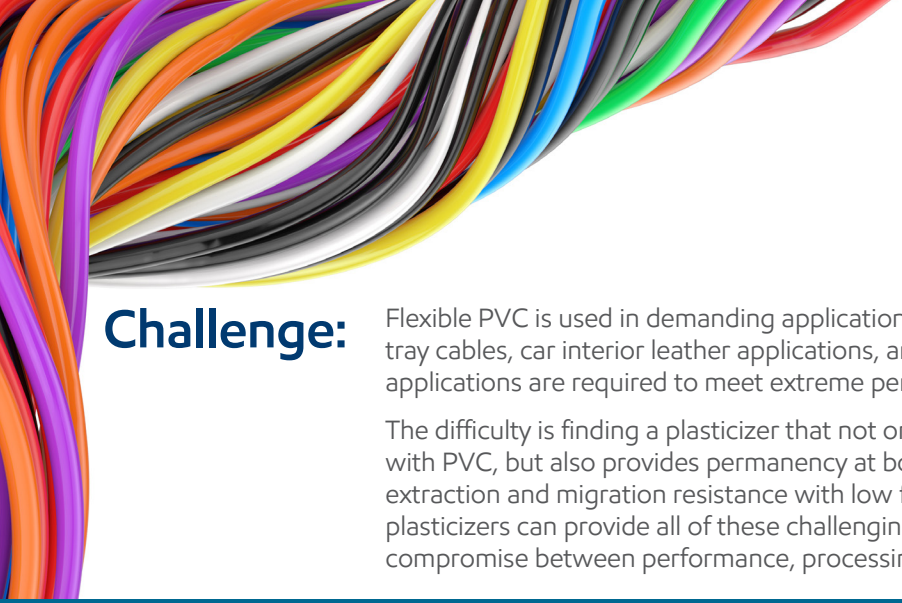
High-performance plasticizer meets demanding flexible PVC requirements

SpecialChem
The material selection platform

Jayflex™ L9TM trimellitate plasticizer

ExxonMobil



Challenge:

Flexible PVC is used in demanding applications such as in automotive cables, wind turbine tray cables, car interior leather applications, and refrigerator gaskets. Plasticizers used in these applications are required to meet extreme performance specifications.

The difficulty is finding a plasticizer that not only exhibits excellent mechanical properties with PVC, but also provides permanency at both high and low temperatures while combining extraction and migration resistance with low fogging, and ease of processability. Very few PVC plasticizers can provide all of these challenging properties and the final choice ends up being a compromise between performance, processing properties, and formulation costs.

Solution:

As a plasticizer class, trimellitates represent state-of-the-art low volatility monomeric plasticizers. These plasticizers are used in car interiors and other applications where resistance to high temperature is required. Jayflex™ L9TM is a linear plasticizer from ExxonMobil that offers a unique balance of performance relative to other branched and linear trimellitates, making it a good fit for high-performance applications.

The performance properties in Table 1 compare Jayflex L9TM to other trimellitates. The performance data also show that linear trimellitates outperform branched trimellitates in many areas, making them more suitable for high performance applications. The linearity helps reduce plasticizer volatility, improve plasticizer efficiency, low temperature flexibility, and processability. When compared to another linear trimellitate, such as L810TM (octyl decyl trimellitate), Jayflex L9TM provides greater fogging performance.

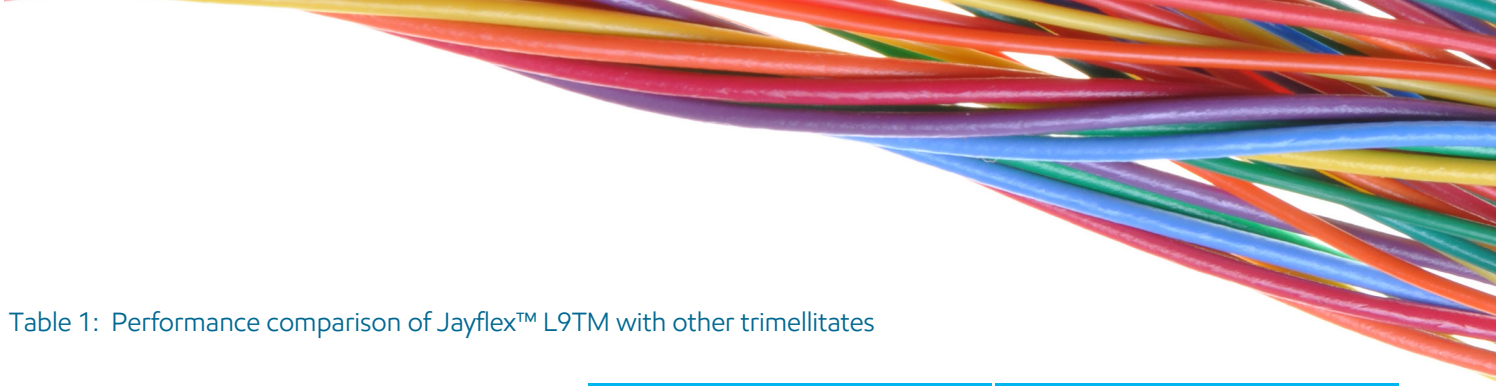


Table 1: Performance comparison of Jayflex™ L9TM with other trimellitates

	BRANCHED		LINEAR	
Plasticizer (PHR)	**TOTM**	**Jayflex TINTM**	**JayflexL9TM**	**L810TM**
Viscosity (mPa.s, 20°C), ASTM D445	295	94	161	139
Density (g/cm^3, 20°C), ASTM D4052	0.989	0.978	0.973	0.973
Molecular weight (calculated)	547	589	589	589
Low temperature performance	+	=	++	++
Weight loss	=	++	+++	+++
Fogging	=	+	+++	++
Cold T° flexibility	=	=	++	++
Low extraction / migration	+	++	++	++
Efficiency factor	1.17	1.27	1.2	1.17
Dry blend time (function of plasticizer viscosity, solvency power)	=	−−	−	−

Source: Based on ExxonMobil internal assessment and literature

Key benefit 1: Excellent resistance to high and low temperatures

High temperature performance in flexible PVC is related to two key properties: Plasticizer volatilization and plasticizer degradation (thermal stability). The low temperature performance is generally improved by the amount of plasticizer used, but is also affected by the degree of linearity of the plasticizer alkyl chains. The low compound weight loss (Table 2) after ageing allows for extreme performance in wire and cable applications. PVC plasticized with Jayflex™ L9TM also meets automotive cable Class C applications (3000 h 125°C).

Table 2: Hardness, thermal weight loss, and low temperature flexibility of Jayflex L9TM compared to other trimellitates

Plasticizer (PHR)	L9TM (30) DTDP (20)	TINTM (30) DTDP (20)	L9TM (40)	L810TM (40)	TOTM (40
Shore A	93	94	95	93	94
Shore D	38	41	46	45	45
Weight loss (7 days @136°C), wt%	4.4	4.5	0.8	0.7	3.1
Clash Berg ($T_{F,}$ °C)	-32	-23	-20	-22	-9

(Formulation: 100 phr OXY 240F resin; 3 phr Sb203; 10 phr Clay; 4 phr Naftosafe PKP314 and 0.25 phr stearic acid).

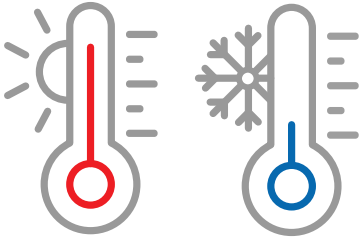
Jayflex™ L9TM exhibits good thermal stability showing little difference between stabilized and un-stabilized plasticizer performance in compounds (Table 3). Not only resistant to high temperatures, Jayflex L9TM also exhibits excellent low temperature properties (Clash Berg, ASTM D1043), which is desired for wind turbine tray and plenum cable applications. These low temperature properties are substantially better than branched trimellitates (ex. TOTM). In addition, Jayflex L9TM does not crystallize at very low temperatures (Tg ~ -79 °C, measured by Differential Scanning Calorimetry).

Additional applications that can benefit from the combined high and low temperature properties of Jayflex L9TM plasticized PVC include car interior leathers, refrigerator gaskets, geomembranes, and flexible hoses.

Table 3: Thermal stability of Jayflex™ L9TM (VDE 0271 tests at 200 °C - Congo red test)

Plasticizer (50 PHR)	Time, minutes
Jayflex L9TM un-stabilized	83
Jayflex L9TM - 0.1% TCA	86
Jayflex L9TM - 0.15% TCA	89

Other components: 100 phr OXY 240F resin 4 phr Naftosafe PKP314 0.25 phr stearic acid.



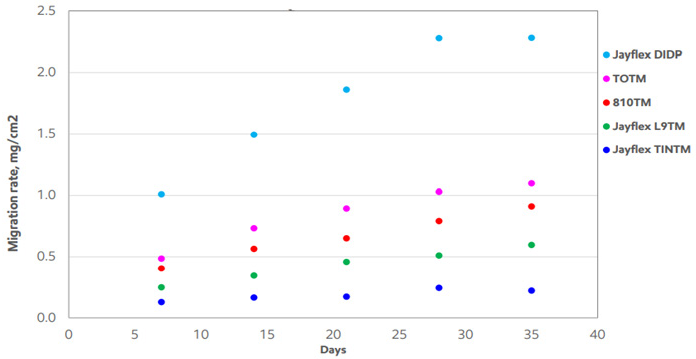
Key benefit 2: Migration resistance

When plasticized PVC comes into contact with other materials, the plasticizer may migrate out of the PVC matrix. It also can be extracted using different solvents, including water. The key characteristic for migration and extraction resistance is molecular size. However, linearity can be indicative of higher levels of migration and extraction.

Excellent migration resistance is especially important for car interior dashboard applications, in which a flexible PVC skin comes in contact with a polyurethane foam. Without plasticizers offering sufficient migration resistance, the flexible PVC material will lose its dimensional stability, become stiffer over time, produce reduced strength and cracking.

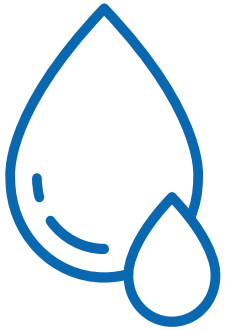
Jayflex™ L9TM is unique in that it provides excellent resistance to migration and extraction, as illustrated in Figure 1. The migration rate is determined by measuring the weight change in stacked 5 cm disks at 50°C where disk 1 had a plasticizer content of 70 phr and disk 2 had a plasticizer content of 35 phr.

Figure 1. Migration resistance of trimellitate plasticizers at 50°C



Formulation: S-PVC (Oxy240F) 100 phr; Plasticizer 70 or 35 phr; Filler 10 phr ; Paraplex G62 5 phr ; Mark 1221 3 phr; Stearic acid 0.25 phr

Key benefit 3: Low fogging



Fogging is referred to as the condensation of volatile substances from various components of car interiors on the inner surface of the windscreen. Car interior trim assembly parts, for example, instrument panels, door panels and seats are required to exhibit low fogging.

In the case of plasticizers, higher concentrations of plasticizers can lead to increased fogging, therefore plasticizer type and efficiency are important criteria. Higher molecular weight and more linear plasticizers tend to exhibit superior performance, while linear trimellitates have achieved high levels of acceptance in low-fogging applications. Table 4 shows the low fogging performance of Jayflex™ L9TM compared to DIDP, as measured by VDA 278 and DIN 75201. The fogging resistance of Jayflex L9TM is considered to be superior to the more linear Jayflex L810TM, depicted in Table 1

Table 4: Fogging resistance of Jayflex™ L9TM plasticized PVC compared to DIDP

Plasticizer	VDA 278 FOG in ppm	VDA 278 VOC in ppm	DIN 75201B gravimetric in mg	DIN 75201A retained gloss %
Jayflex DIDP	83	396	0.7	80
Jayflex L9TM	64	158	0.29	92

Conclusion

Selecting the right plasticizer for more demanding flexible PVC applications is difficult when both low temperature and high temperature resistance is required, as well as, providing good flexibility, thermal stability, low fogging, and migration / extraction resistance. Jayflex™ L9TM , a linear trimellitate from ExxonMobil, provides an excellent choice to satisfy these multiple requirements without sacrificing plasticizing efficiency and cold temperature performance.

Jayflex L9TM plasticizer has superior performance properties expected from a linear trimellitate while reducing plasticizer contribution to fogging. As a result, flexible PVC materials can be used in automotive Class C cables, wind turbine tray and plenum cables, automotive interior leather applications, refrigerator gaskets, lubricant applications (ex. engine, compressor, gear oils), and other high performance applications.

In addition to the performance benefits, ExxonMobil offers automotive industry players extra value through reliable material supply. Linear trimellitates are based on linear alpha olefins, which the company announced the construction of a new linear alpha olefins (LAO) manufacturing unit at its Baytown, Texas integrated petrochemical complex. The estimated commercial startup of the facility is set for mid-2023, and when operational, it will have the capacity to produce approximately 350,000 metric tons of LAO annually.

Meet the most demanding automotive applications with Jayflex™ L9TM

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