Recovery – The Key to Athletic Performance

Foams Based on INFUSE™ OBCs Offer Exceptional Recovery Properties Compared to Incumbent EVA

In the world of high performance athletics, recovery after training or competition is key to performing at peak levels. This is also true for athletic footwear. Since their introduction to the footwear market in 2011, INFUSE™ Olefin Block Copolymers (OBCs) have enabled the development of athletic shoe midsoles with significantly improved performance, including strong recovery after several compression and release cycles.

This advanced technology from The Dow Chemical Company (Dow) offers opportunities for excellent long-term cushioning performance with outstanding rebound, comfort, and durability when used alone and significantly improved performance in blends with ethylene vinyl acetate (EVA) – the historical, low-cost industry standard.

Another recent innovation, expanded thermoplastic polyurethane (E-TPU), has received widespread attention for its energy management capabilities. This closed-cell, elastic particle foam provides softness and flexibility using bead foam technology to offer improved rebound and many other similarities to OBC-based foams.

Figure 1: Rebound Performance[1]

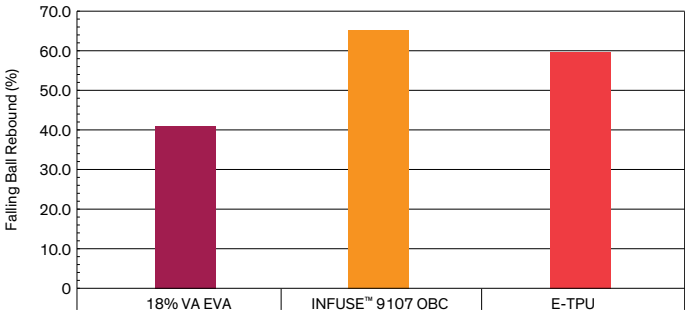


Figure 2: Static Compression Set at 23°C/22 hrs[1]

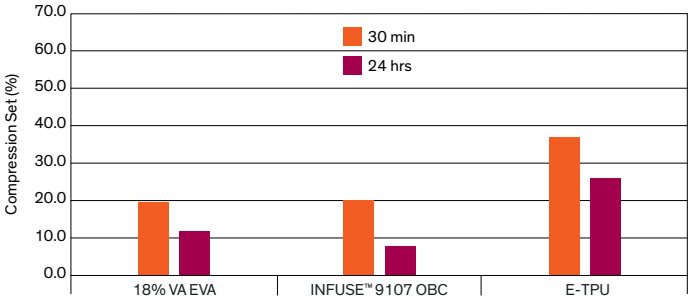
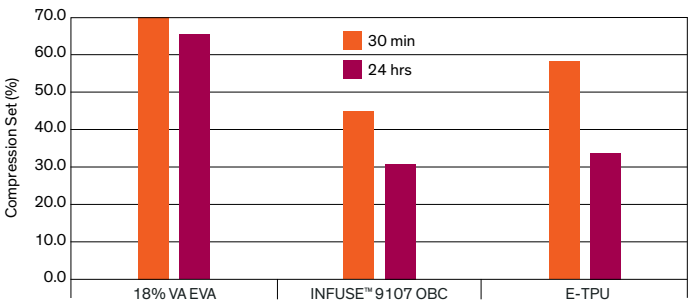


Figure 3: Static Compression Set at 50°C/6 hrs[1]



[1] Data per tests conducted by Dow. Additional information available upon request. Properties shown are typical, not to be construed as specifications. Users should confirm results by their own tests.

Rebound

Rebound performance is an important aspect of footwear energy management. In addition to helping cushion the foot from impact, high levels of rebound also help propel the athlete onward. Figure 1 illustrates that foam made with INFUSE™ 9107 OBC can help improve performance compared to conventional EVA (at the same density) and E-TPU (made to the same Durometer hardness) (see Table 1).

Compression Set and Recovery

Low compression set and strong recovery also play important roles in developing durable and long-lasting midsoles. Figures 2 and 3 compare compression set at room and elevated temperatures after 30 minutes and 24 hours of recovery. At room temperature (Figure 2), the 18 percent VA EVA foam tested displays low compression set like the OBC-based foam. However, when aged at 50°C for six hours and allowed to recover for 24 hours (Figure 3), the EVA shows significantly higher compression set resistance and very little recovery. The E-TPU sample tested shows slightly higher compression set before and after recovery and – like the OBC-based foam – enables significant improvements in compression set resistance compared to EVA at elevated temperatures.

Table 1: Initial Dynamic Fatigue Sample Properties[2]

		21% VA EVA	INFUSE™ 9107 OBC	E-TPU
Shore A	Foam	31.2	14.2	16.3
Asker C	Foam	52.8	31.4	29.0
Foam Density, g/cc	Foam	0.155	0.183	0.158
Rebound, %	Foam	38.2	61.6	59.8
Density Before, g/cc	Skin (Foam)	**0.187**	**0.200**	**(0.158)**
Sample Thick, inch	Before	**0.826**	**0.917**	**0.826**
Sample Area, inch²	Before	**2.47**	**2.32**	**2.26**

[2] Crosslinked foam samples were prepared by a compression molding "bun" foam process and were not molded using a secondary molding technique. Additional information available upon request. Users should confirm results by their own tests.

In previous dynamic fatigue testing conducted by Dow, samples were tested for 100,000 cycles at 40°C with a force of 180 lbs per cycle and allowed to rest at room temperature to measure the recovery over time. The INFUSE™ OBC-based foam and E-TPU sample recovered up to 90 percent of their original thicknesses, while the EVA sample recovered only about 7 to 10 percent.

In another round of testing designed to better approximate the cyclic conditions a runner typically encounters, the samples were tested under the same conditions, except that the number of cycles was limited to 10,000 per "run" with a 22-hour rest period between each run. The change in sample thickness was measured before and after each set of 10,000 cycles.

Figure 4 shows the results of the successive runs on foams made from EVA, INFUSE™ OBC and E-TPU. The EVA sample demonstrates the highest change in sample thickness over the same number of cycles. It was also observed that the EVA sample did not recover any of its original thickness during the rest period – and actually showed a decrease in thickness over the rest time. In sharp contrast, the OBC and E-TPU foams showed a noticeable recovery in thickness. By the end of the 100,000 cycles, the EVA lost 30 percent of its original thickness, while the INFUSE™ OBC-based foam and E-TPU sample each lost less than 20 percent.

The recovery over time following a total of 100,000 dynamic compression cycles at 40°C is shown in Figure 5. The INFUSE™ OBC-based foam and E-TPU show the ability to recover up to 93 percent of their original thickness over time. This ability to recover over time following static and dynamic compression points toward extended durability and service life.

Figure 4: Recovery After Each 10,000 Dynamic Fatigue Cycle[1]

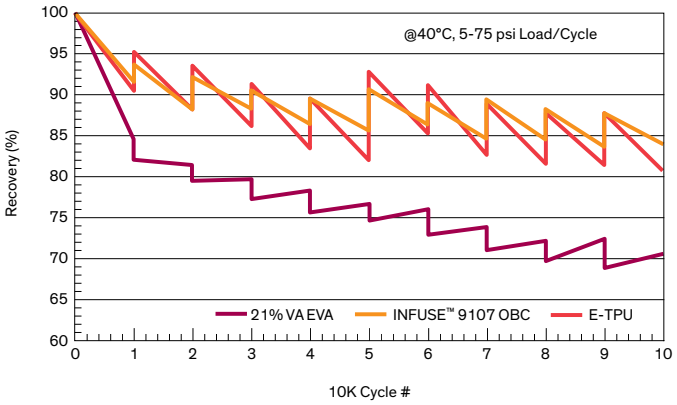
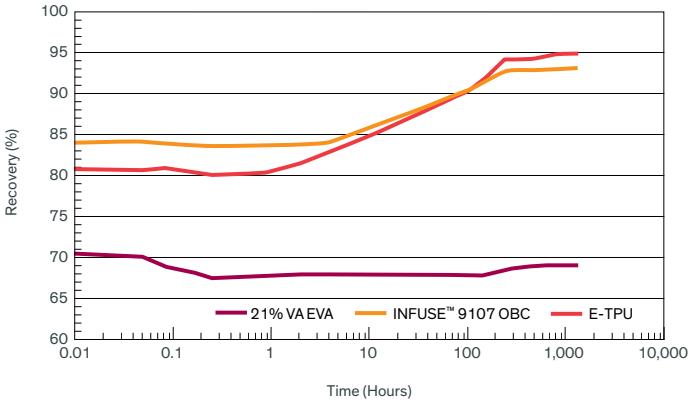


Figure 5: Recovery After 100,000 Total Cycles at 40°C[1]



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Recovery is the Key to Consistent Performance

INFUSE™ OBC-based foam demonstrated:

- Higher percent rebound, elevated temperature compression set resistance, and higher recovery after 24 hours compared to conventional EVA foam.
- Much higher recovery after several repetitive dynamic fatigue cycles including a 22-hour rest period between testing cycles.
- In addition, midsoles made with up to 100 percent INFUSE™ OBC content can be bonded with other footwear components using recently developed Dow technology in collaboration with global primer and adhesive suppliers.

Speak to your Dow representative about improved bonding capabilities for high INFUSE™ OBC content applications.

For more information on how INFUSE™ OBCs can help improve your performance footwear or other foam applications, contact your Dow representative, visit www.dowfootwear.com, or call the nearest location listed below.

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