



Improved Warm-Mix Asphalt Formulation

(ROI #2015-12)

Description

- More than 90% of our roadway pavements are surfaced with asphalt materials. Warm mix asphalt refers to a group of various technologies that helps to reduce production and construction temperatures of hot mix asphalt used in asphalt pavements. The warm mix additive formulated at Louisiana Tech is to be added with asphalt binder during hot mix asphalt production. Upon addition this new additive produces significant foaming of asphalt binder that reduces its viscosity and allows production and compaction of asphalt mix at warm temperatures. This warm mix additive produces 6 to 10% more moisture for foaming of the asphalt binder. This results in producing 3.5-3.8 times volumetric expansion of the asphalt binder compared to 1.4-1.6 times volumetric expansion of commercially available similar additives. Laboratory performance of the warm mix asphalt produced with this new technology showed similar or better performance compared to warm mix produced with commercially available similar technologies with respect to pavement rutting and moisture susceptibility tests. This warm mix additive is novel and it is less costly.

Advantages

- Reduces asphalt mix production costs
- Reduces paving temperatures
- Less susceptible to moisture

Areas of Application

- Re-surfacing of roadways

Patent Status

- Patent pending

Changing from Hot to Warm

Hot mix asphalt (HMA) is a combination of approximately 95% stone, sand or gravel bound together by asphalt. Conventional HMA is typically mixed and compacted at temperatures from 280°F to 320°F (140°C to 160°C). Warm Mix Asphalt is produced and applied at a temperature around 20° - 40°C lower than an equivalent Hot Mix Asphalt (HMA). Warm mix asphalt technology can reduce production temperature by as much as 20%.

Benefits of Warm Mix Asphalt

- ❑ Energy consumption is reduced by 30%
- ❑ The reduced fuel and energy usage gives a reduction of the production of greenhouse gases and reduces the CO₂ / Carbon footprint
- ❑ Reduce fume and odor emission by 50% and creates cooler working conditions for the asphalt workers

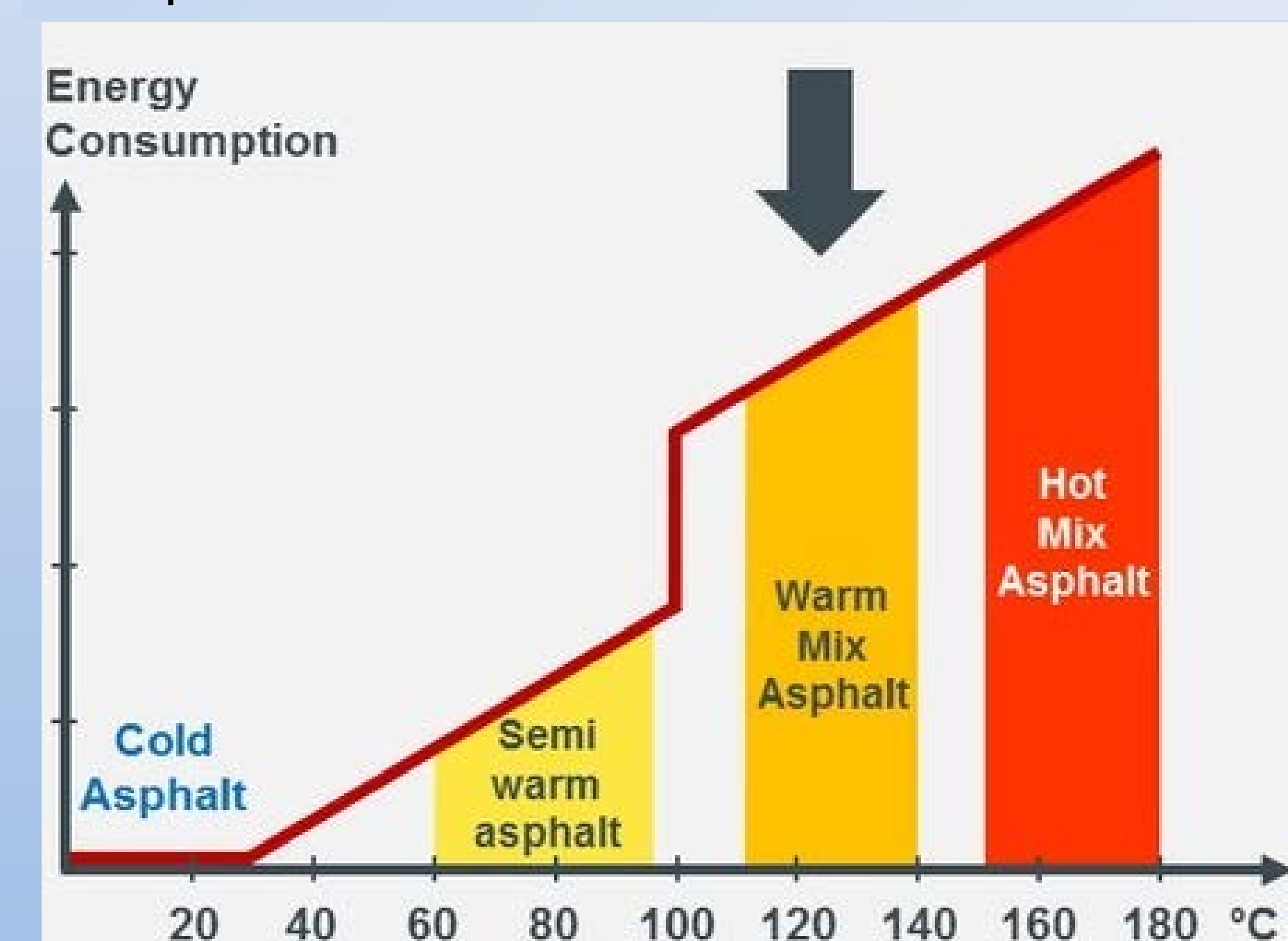


Fig 1. Schematic diagram of the energy consumption of different asphalt mix technology. (1)

New Technology Invented in the Study

A new additive product for warm mix asphalt and a formulation process is invented in this study. Using an industrial by-product as a raw material. The new product falls in the category of the WMA foaming additives. It releases moisture from the crystalline structure and starts foaming the asphalt binder.

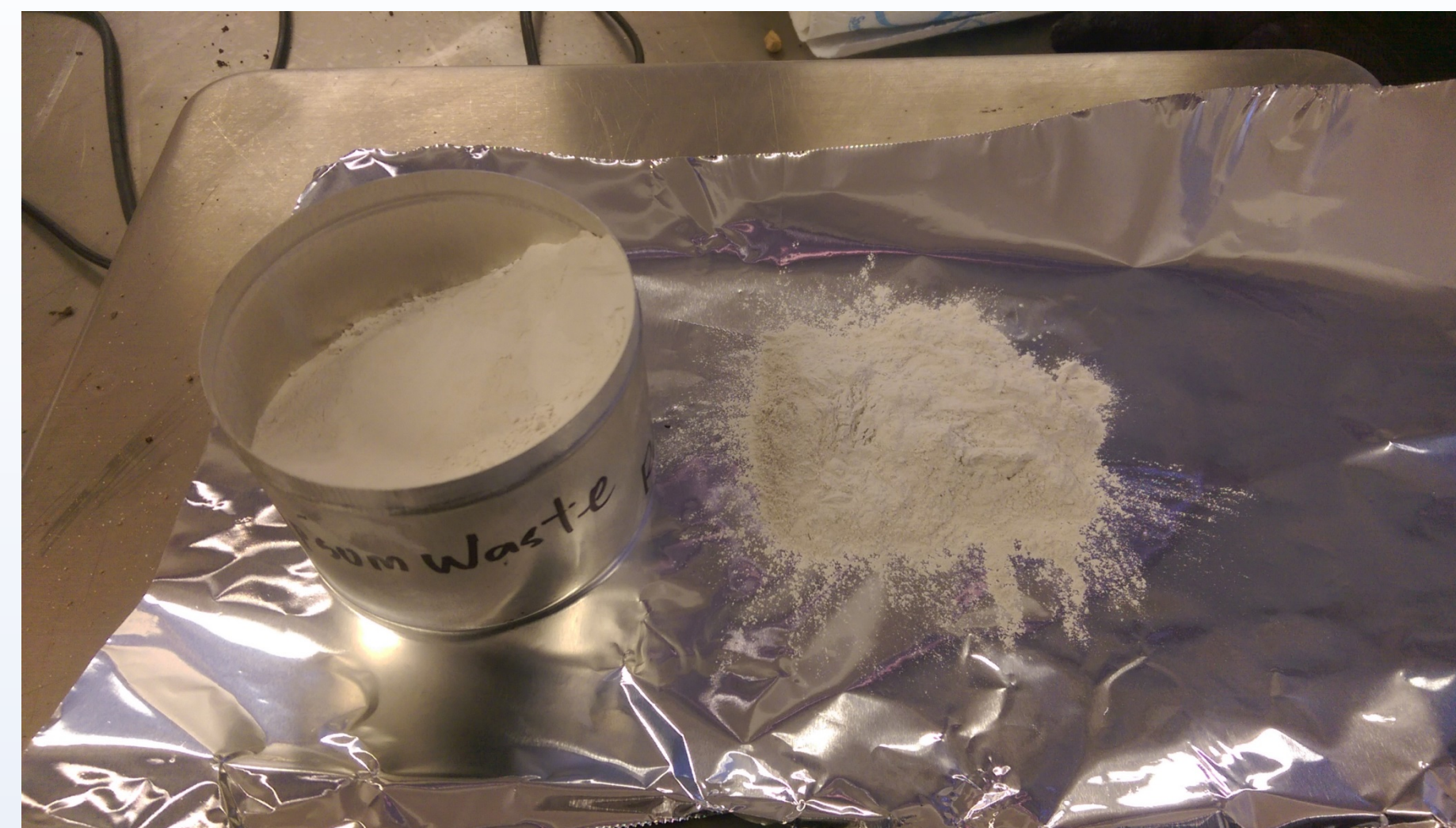


Fig 2. Processed industrial by-product to be used in the mixture

Advantage of the New Product

The new product has following benefits over the currently available commercial indirect foaming additives:

- ❑ Contains 6 to 10% more moisture in its crystalline structure for foaming of asphalt
- ❑ 3.5 - 3.8 times volumetric expansion of asphalt which is almost double of the currently commercially available additive
- ❑ Raw material is an industrial by-product; as a result, it is cheap.
- ❑ Louisiana, Texas, Delaware and New Jersey have a large stockpile of this by-product material.
- ❑ 90,000 metric tons of this by-product material is generated annually in the United States.

Moisture Release and Reabsorption

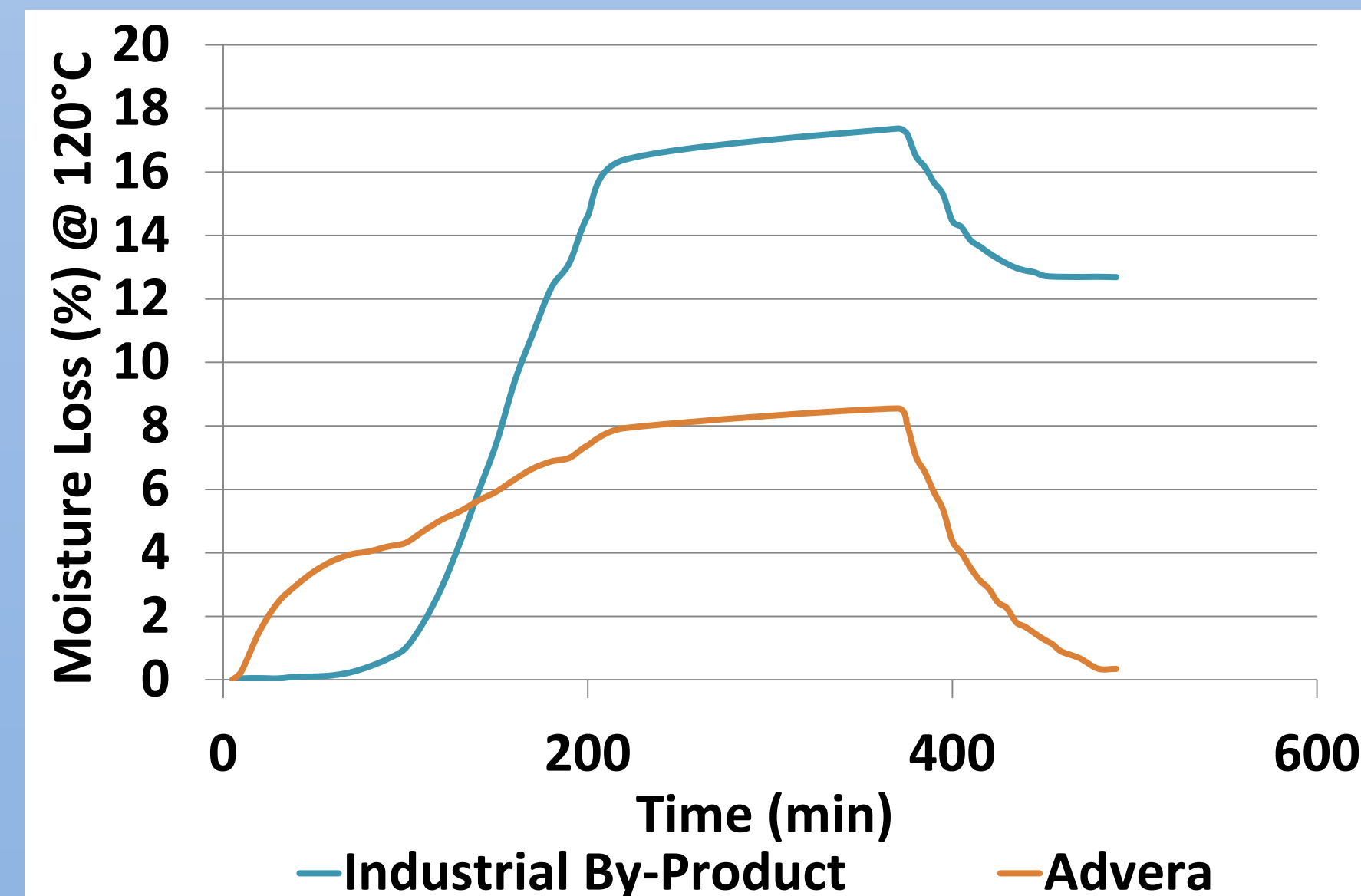


Fig 3. Moisture loss and reabsorption @120°C

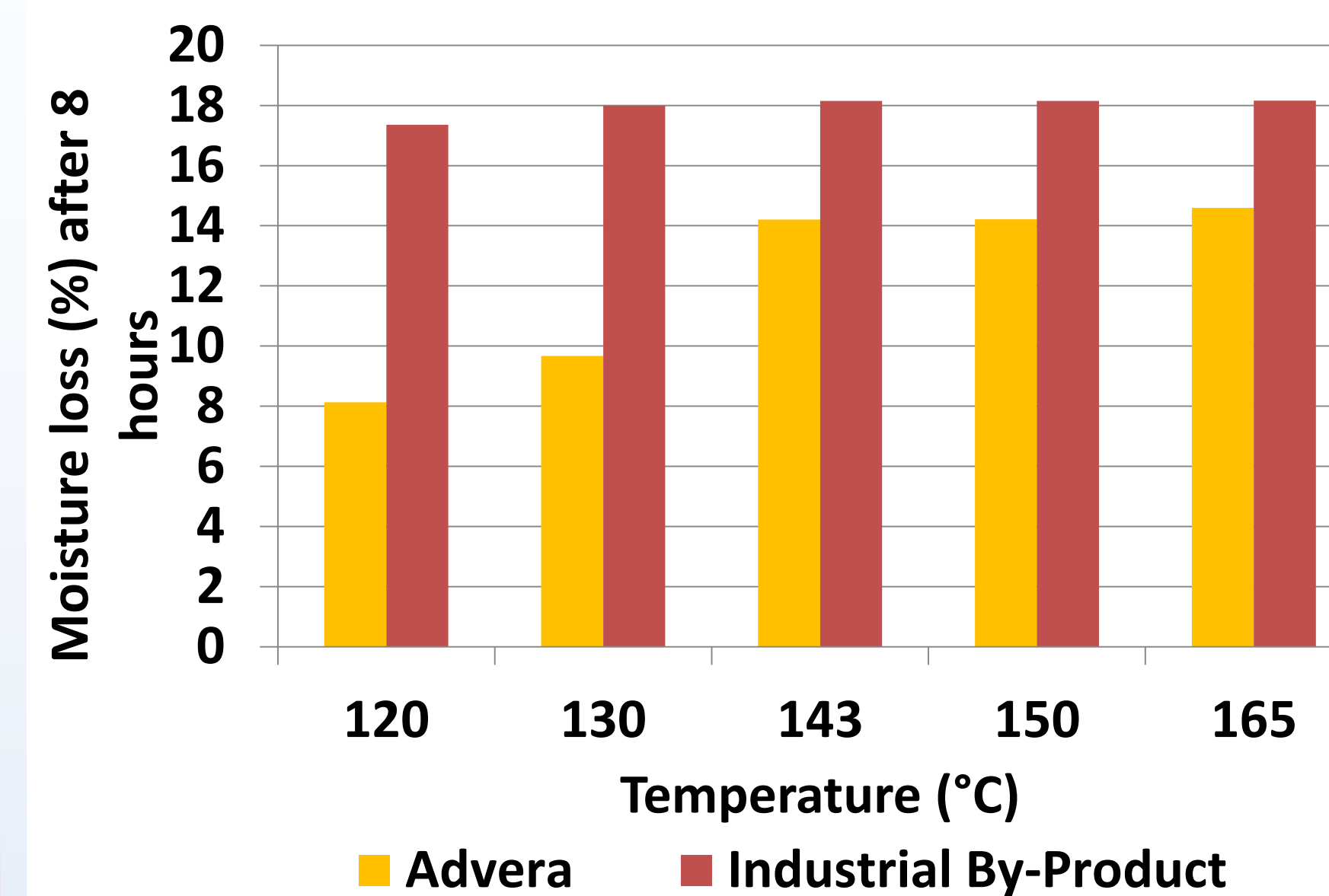


Fig 4. Maximum amount of moisture release at different temperature for Advera and the new product.

Volumetric Expansion of Asphalt (Foaming)

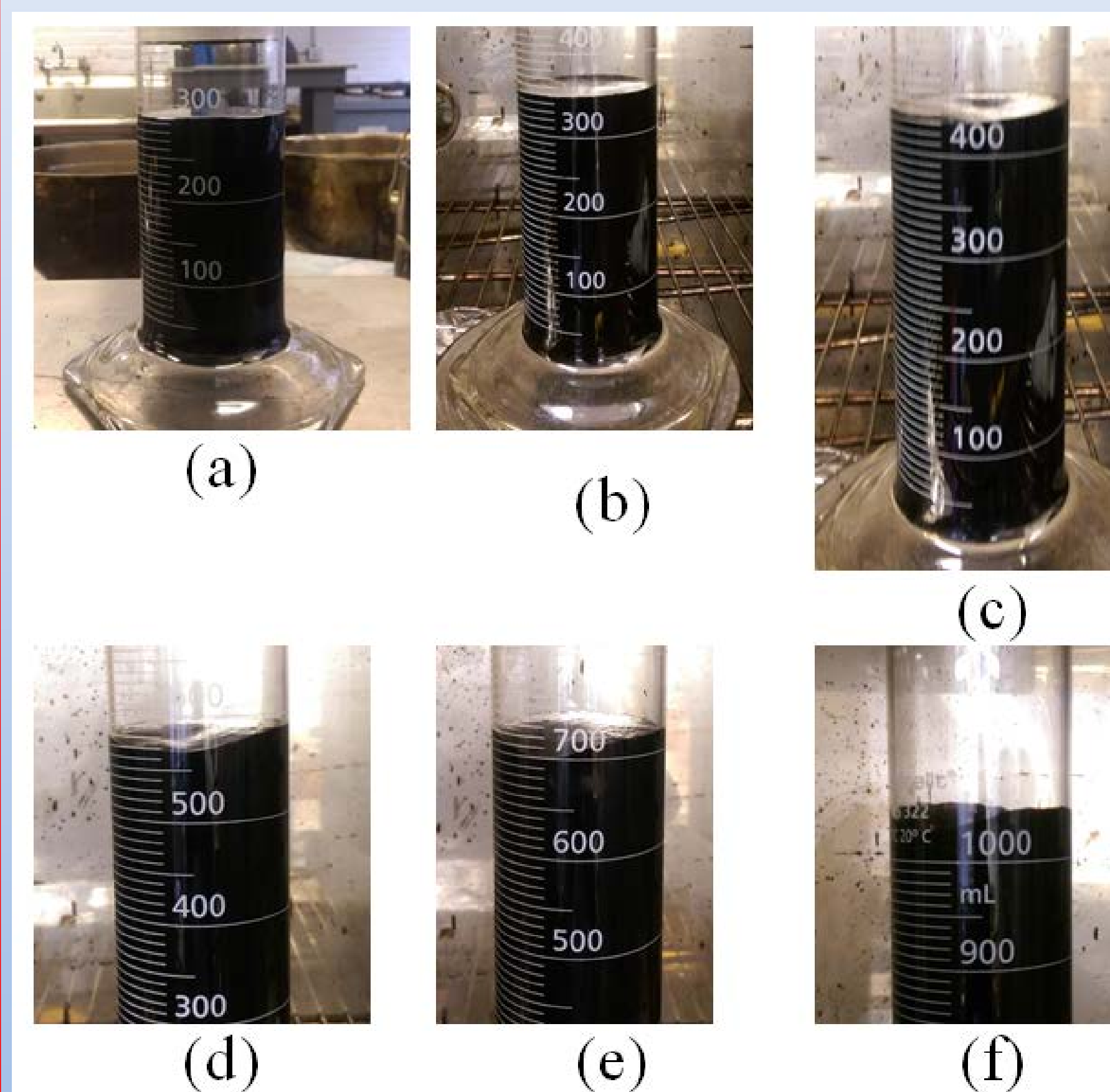


Fig 5. Volumetric Expansion of the binder after the addition of the new product.

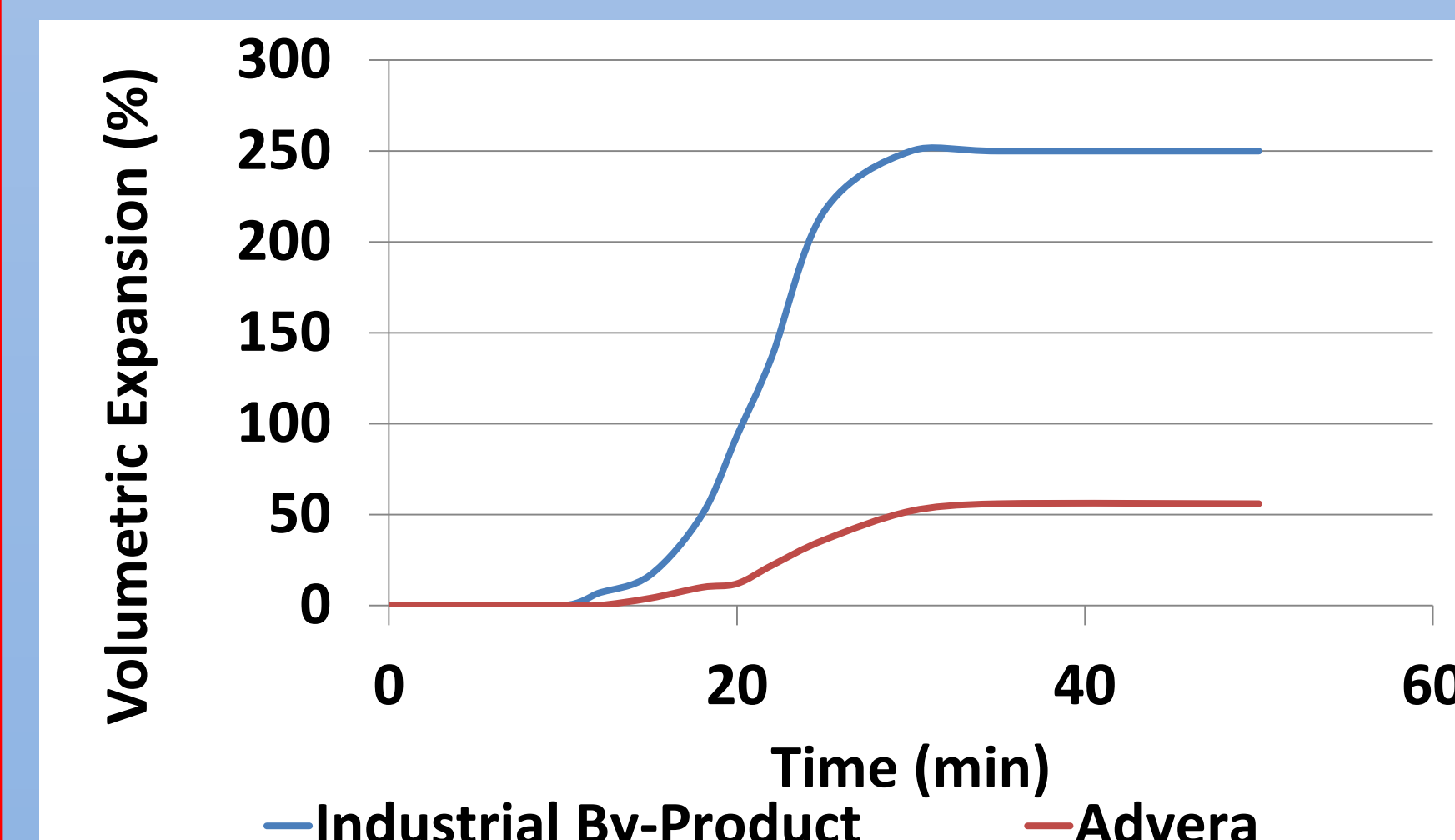


Fig 6. Volumetric expansion of PG 64-22 binder after the addition of additives.

Densification of the Compacted Mixture

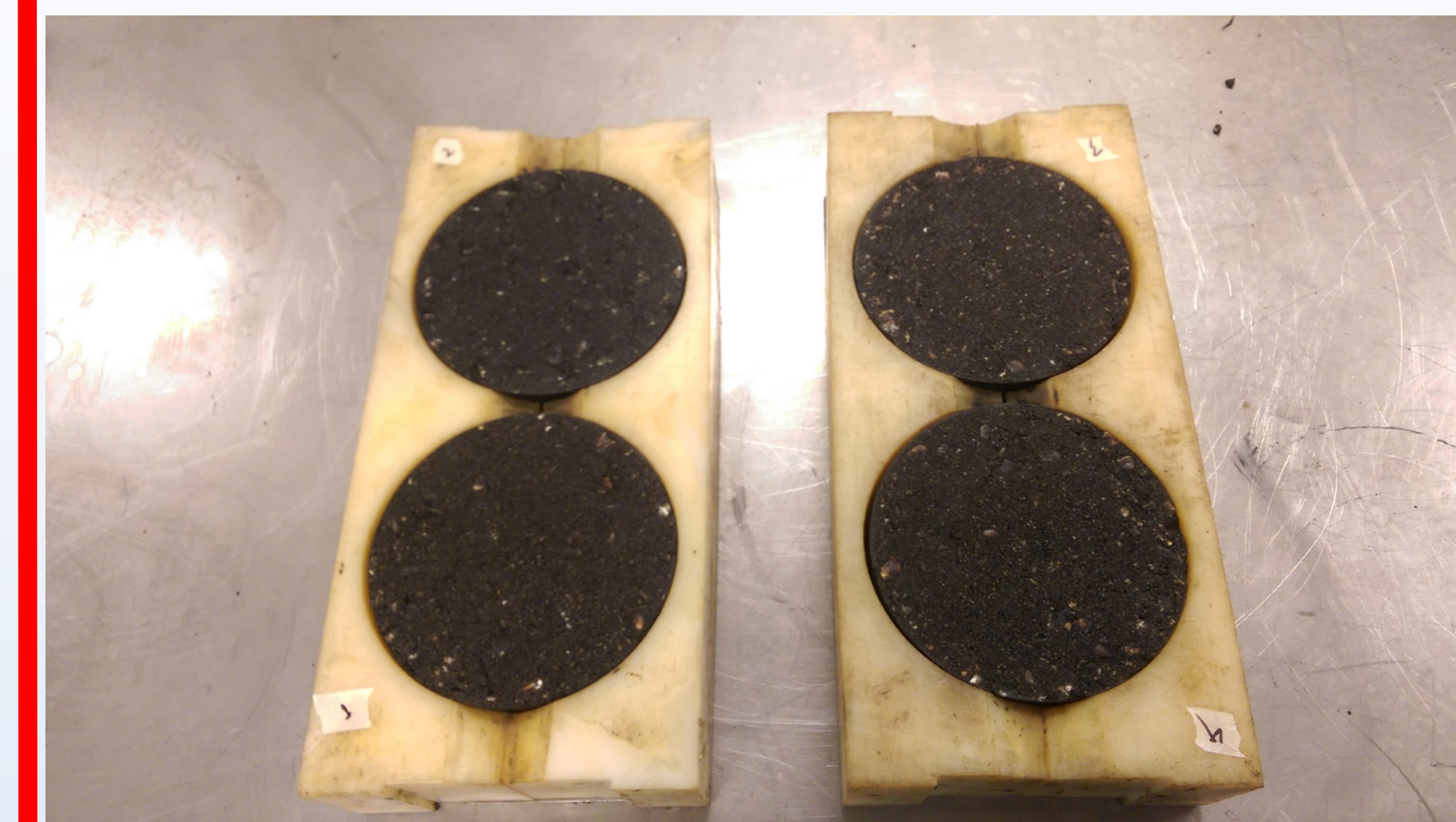


Fig 7. compacted asphalt mixture prepared at 130°C using the new product.

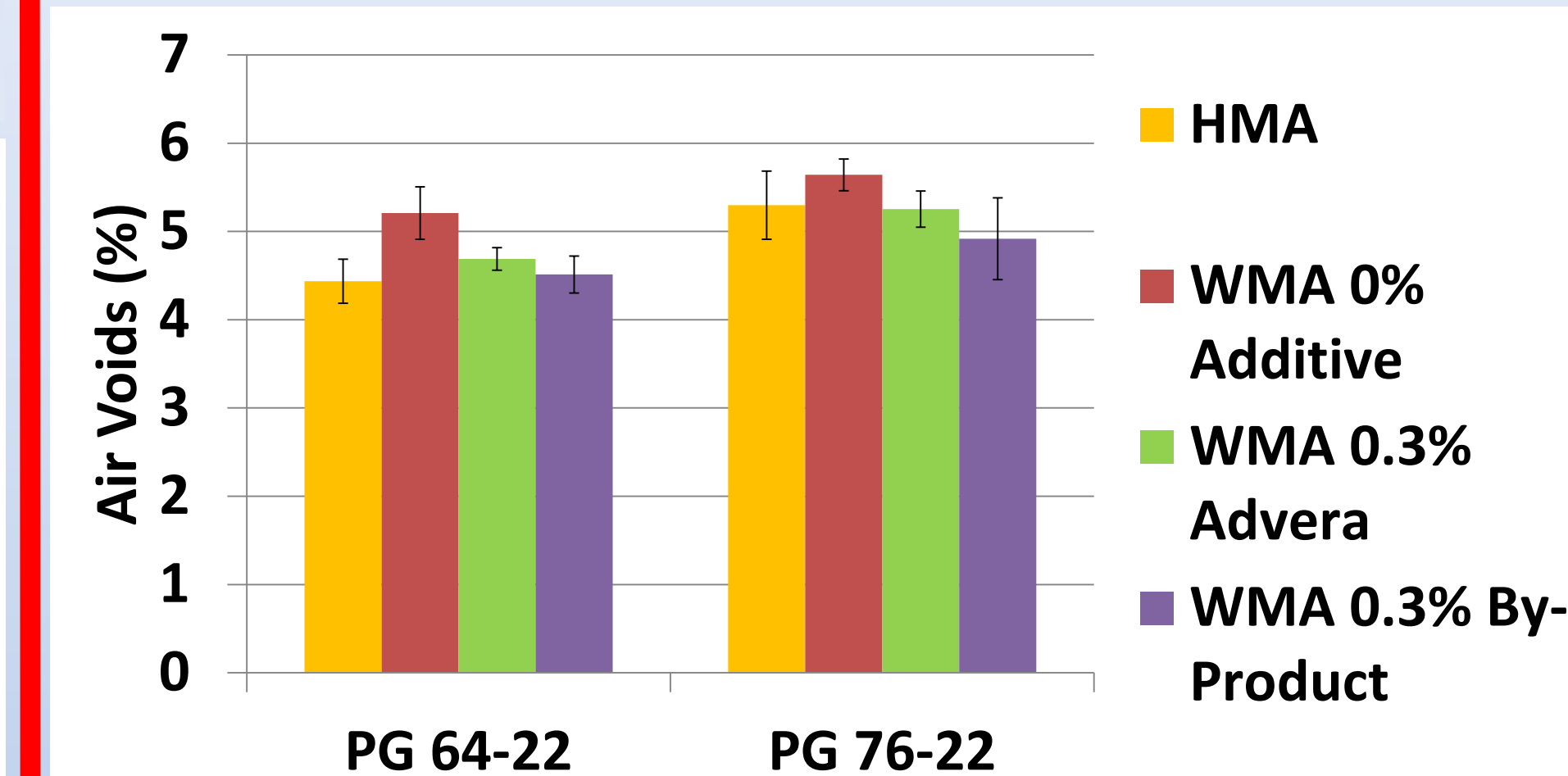


Fig 8. Densification results for different additives

Conclusions

- ❑ The New product and formulation method invented has several benefits over the currently available product.
- ❑ Performance testing results imply that the new product performs on a similar level to that of an existing WMA additive.
- ❑ Recycling a Industrial by-product material and using it to reduce production temperature creates a two way benefit for the environment.

Reference

- (1)<http://en.marinierrmont.fayat.com/TECHNOLOGY/Warm-mix>
- <http://www.eapa.org/asphalt.php?c=199>
- Prowell, B. D., G. C. Hurley and B. Frank. Warm-Mix Asphalt: Best Practices (2nd Edition), Quality Improvement Publication 125, National Asphalt Pavement Association, February 2011.
- Corrigan, M., Newcomb, D., and Bennert, T. "From Hot to Warm", Public roads, July /August 2010