THE SCIENCE BEHIND CORAFOAM® HDU
A CASE STUDY

The specialized “continuous” manufacturing technique used to produce CORAFOAM® HDU has multiple benefits, from cell-structure to mechanical properties.

DUNA-USA
FOAMS & CHEMICALS

INTRODUCTION TO CORAFOAM®

High density CORAFOAM® is a sign substrate manufactured by DUNA-USA, originally created in the 1950's for use as mechanical insulation for pipeline applications and other industrial applications. In the early 2000's, DUNA developed the CORAFOAM® high-density line of polyurethane boards, purpose built to offer excellent carvability and surface finish characteristics for the signmaking, millwork, and carpentry industries.

CORAFOAM® APPLICATIONS

1. **General Applications.**
   Signmaking, Pattern Making, Core-Material, Prop and Set Design Pieces bullet points

2. **Additional Applications.**
   - Wood replacement for architectural elements
   - Thermoforming master models
   - Composite layup tools

WHAT IS CORAFOAM® HDU?

CORAFOAM® is a closed-cell, rigid polyurethane foam insoluble by water and impervious to solvents. CORAFOAM® is also non-toxic, and it is compatible with a great variety of paints and primers, allowing for multiple aesthetic effects to be achieved. When used outdoors as a wood replacement for signage, it will last forever, and has a lifetime warranty by DUNA-USA.

THE "CONTINUOUS" PRODUCTION TECHNIQUE IS VERY DIFFERENT THAN OTHER MANUFACTURERS. WHAT IS IT?

DUNA-USA produces high-density CORAFOAM® using a specialized "continuous" manufacturing technique. This technique involves a conveyor, approximately 100 feet long, and CORAFOAM®, starting in liquid form, which is then poured onto the moving conveyor while undergoing a chemical reaction and turning from liquid, into CORAFOAM®.

WHAT ARE THE ADVANTAGES OF DUNA'S SPECIALIZED CHEMISTRY AND CONTINUOUS MANUFACTURING TECHNIQUE?

The main advantage of in-continuous technology is a dramatic increase of reproducibility of results, which translates to a high degree of consistency in terms of quality and characteristics. Additionally, the in-continuous process can be driven and controlled in real-time. The entire system is CPU-controlled thorough dedicated software, which automatically monitors all parameters, allowing for adjustment if needed during manufacturing. This is a powerful tool to ensure quality of the boards.

By producing in a continuous process, the end-results are:

- Average cell diameter is smaller and more evenly distributed, resulting in a more uniform consistency and smoother surface
- The finished product is easier to finish, has increased durability, and less chance of voids than HDU produced in a discontinuous fashion.

Proprietary CORAFOAM® formulation renders higher mechanical properties and higher durability compared to other HDU foams with comparable density.

Comparison of cellular size distribution

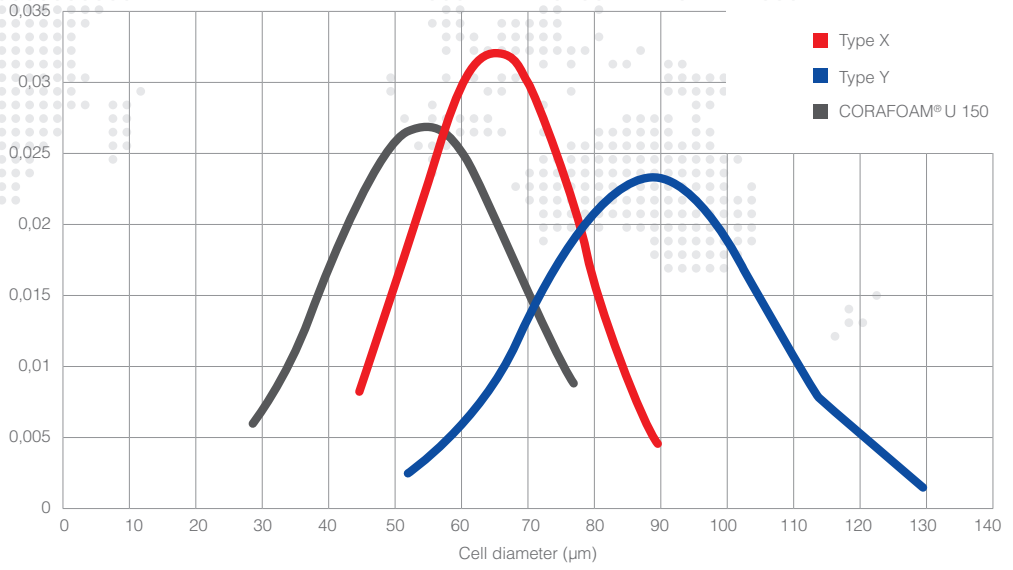


Figure 1: Comparison of cellular size distribution (microns)

Average cell diameter of CORAFOAM® is 55 microns. Brand X has an average cell diameter of 65 microns, and Brand Y has an average diameter of 90 microns.

The smaller cell size diameter makes for a smoother surface, which in the sign and millwork industries, can translate to not only less labor required for priming and finishing, but also less primer/coating to achieve a similar finish as competitive brands.
Additionally, the smaller cell-size diameter allows for a higher degree of detail when routing or carving.

In addition to more strength, higher mechanical properties can also provide better screw and fastener retention as evidenced in the chart and photo below.

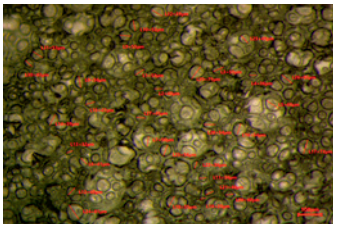


Figure 1: CORAFOAM® HDU 15LB - Produced In-Continuous

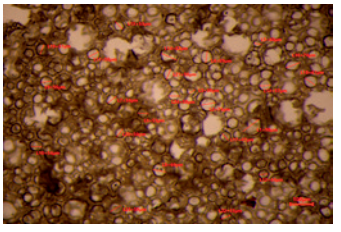


Figure 2: 15lb HDU produced with discontinuous technology (Brand X)

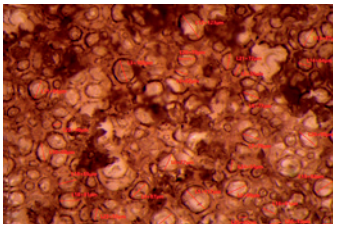
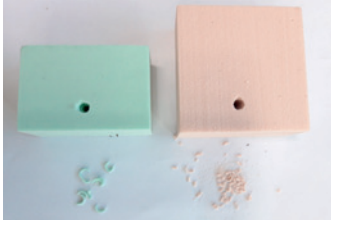
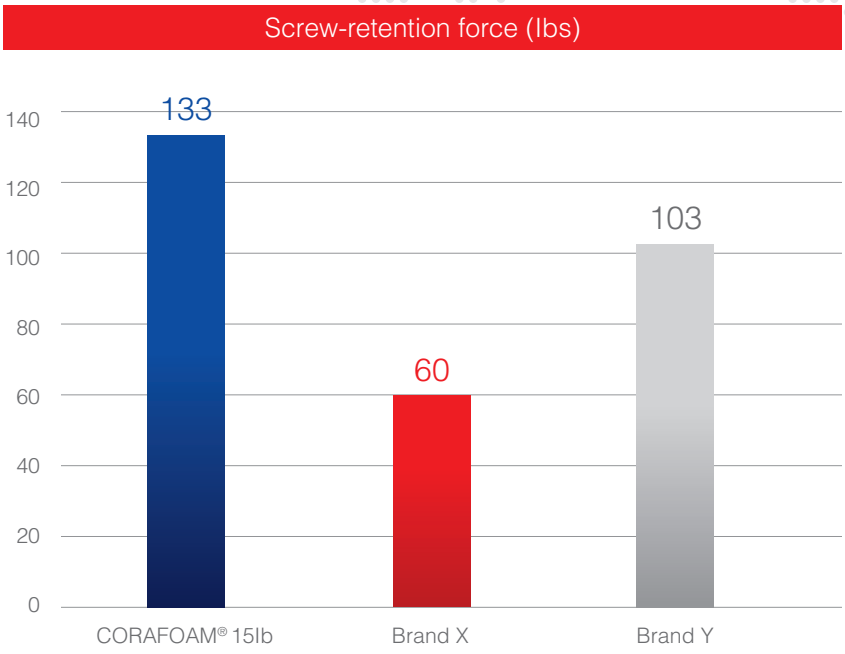


Figure 3: 15lb HDU produced with discontinuous technology (Brand Y)



Mechanical Properties Comparison

	Density	CORAFOAM® / DUNA	Brand X	Brand Y	Brand Z
Flexural Strength	15lb	928 psi	649 psi	487 psi	680 psi
Compressive Strength	15lb	638 psi	498 psi	510 psi	530 psi
Flexural Strength	18lb	N/A	928 psi	867 psi	980 psi
Compressive Strength	18lb	N/A	792 psi	856 psi	790 psi
Flexural Strength	20lb	1,450 psi	N/A	960 psi	N/A
Compressive Strength	20lb	1,044 psi	N/A	960 psi	N/A



HOW CAN CORAFOAM® BE FABRICATED?

CORAFOAM® can be cut with anything that can cut wood, including CNC machines, standard woodworking tools, and waterjet cutters.

WHAT ARE THE DIFFERENT DENSITIES CORAFOAM® IS AVAILABLE IN, AND HOW ARE EACH USED?

CORAFOAM® is available in 4, 6, 8, 10, 15, 20, 28 and 31lb/ft^3 densities. For signmaking, 15lb (CORAFOAM® U150) and 20lb (CORAFOAM® U200) are the most commonly used densities, with 15lb being the leader. 20lb DUNA (CORAFOAM® U200) will have a smoother surface, greater durability, and finish even easier than 15lb DUNA.

Most often, customers choose to use 20lb DUNA as opposed to 15lb, when they desire a higher level of detail, or need particularly strong mechanical properties.

The lighter densities are often used for oversize props and letters, and for interior signage or where the weight of higher densities might be prohibitive.

Higher densities, such as 28lb and 31lb are frequently used for prototyping, thermoforming, and pattern making in automotive, marine, and aerospace applications, where metal is overkill, especially in the case of just needing to produce a few prototypes or a limited production run.

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