
ecomate®
It’s time to expand your horizons.
PRODUCT HIGHLIGHTS
AND TECHNICAL INFORMATION

Environmentally friendly blowing agent and family of polyurethane systems.

Since 2002, our vision has been defined – build a better product that is better for the environment. Through continued innovation, **Ecomate®** became a leader in the polyurethane foam industry and our innovative products are leading the way to environmentally conscious technologies. Today, our patented Ecomate® technology is the most tested and proven environmentally-friendly, PFAS-Free, blowing agent on the market.

Compatible in systems for a wide variety of applications.

- Rigid Foams
- Spray Foams
- Integral Skin Foams
- Flexible Foams
- Reaction Injection Molding
- Roto-Mold Applications
- Pour-in-Place Applications
- Viscoelastic
- Appliances/White Goods
- Automotive
- Boardstock
- Continuous Panel Manufacturing
- Commercial Foodservice
- Refrigerated Transportation
- SIPS & Discontinuous Panels
- U.S.C.G. Marine/Flotation

Ecomate® is a versatile solution for blowing agent applications.

Ecomate® is a true liquid blowing agent designed for use in rigid insulating foams, spray foams, integral skin foams, and various flexible foams. FSI and the Ecomate® worldwide distribution team are constantly finding new uses for this versatile blowing agent.

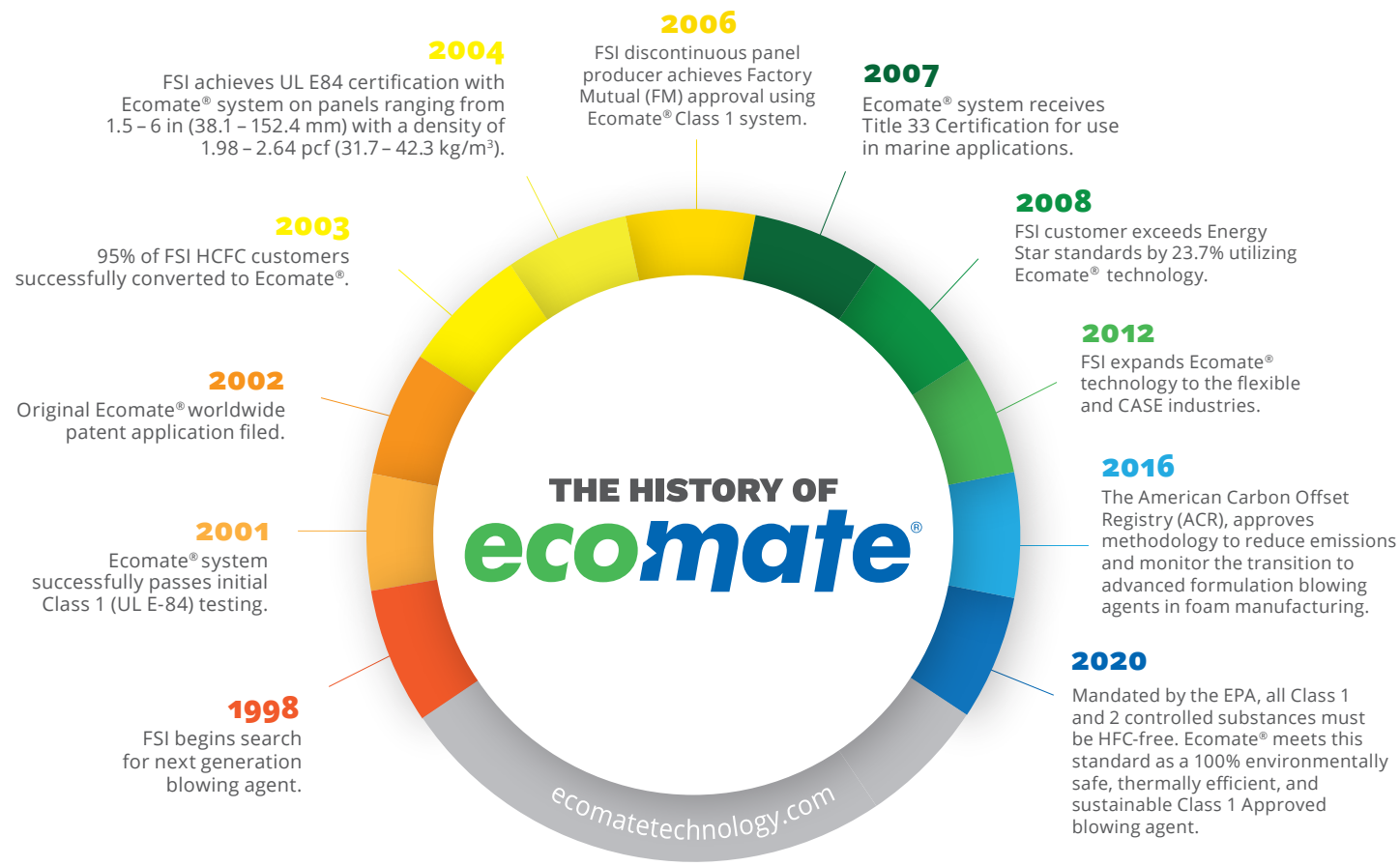
Drop-in replacement. No infrastructure updates needed.

In a world of ever-evolving regulatory compliance, companies want to be up to speed and in compliance with relevant laws, policies, and regulations. With **Ecomate®**, you can rest easy. Because it's environmentally benign, Ecomate® complies with every current regulation pertaining to foam blowing agents. Furthermore, as additional HFCs and other harmful materials are phased out of use, Ecomate® will continue to be a reliable, proven, and affordable foam blowing agent solution.

Headed in the right direction.

As the world continues to transition away from damaging HFC blowing agents with high GWP, **Ecomate®** provides the perfect zero GWP solution to meet fast-changing regulatory requirements, sustainability goals, and consumer demands.

The Significant New Alternatives Policy Program (SNAP), established under the Clean Air Act, allows the EPA to evaluate substitutes for ozone-depleting substances and hydrofluorocarbons (HFCs) targeted by the American Innovation and Manufacturing Act (AIM). This program helps identify safer alternatives to reduce environmental and health risks.



FAST FACT

In one year alone, FSI customers reduced CO_2 emissions by 549,817 mt. Three times greater than the closest competitor.

FAST FACT

Converting customers from HFC to Ecomate technology is equal to the annual greenhouse gas emissions from over 90,000 passenger vehicles, and the CO_2 emissions generated annually by the electricity used in more than 59,000 homes.

Physical Properties

Chemical Name	Ecomate	
Formula	HCOOCH3	
Molecular Weight (g/mol)	60.05	
Boiling Point (at 101.3 kPa, 14.69 psi)	31.5°C	88.7°F
Vapor Pressure (Bar at 20°C, psi at 68°F)	0.62	9
Specific Gravity (20°C, psi at 68°F)	0.98	
Thermal Conductivity of Vapor @ 25°C / 77°F (W/m·K/BTU·in/hr·ft^2 °F)	10.7	0.074
Solubility in Water (23°C / 73.4°F)	330g/kg	33 wt%
Density of Vapor (20°C / 68°F) (Air = 1)	2.07	
Viscosity (25°C / 77°F)	0.355 cps	
Electrical Conductivity (ps / m)	1.92 x 10^8	
Refractive Index	1.343	
Kb Value (ASTM D1133)	25	

Blowing Agent Environmental Impact

Blowing Agent	ODP	GWP	VOC	MW	Ratio*	CO_2e**
Ecomate®	0	0	Exempt	60	1.0	1
HCFC-141b	0.11	725	Exempt	117	1.95	1,413.75
HFC-245fa	0	1030	Exempt	134	2.23	2297
HFC-365mfc	0	794	Exempt	148	2.47	1961
n-Pentane	0	<25	YES	72	1.20	29
Cyclopentane	0	<25	YES	70	1.167	28
Methylal	0	<3	Exempt	76.09	1.26	3
HCFO-1233zd	0.00024-0.00034	4	Exempt	130	2.16	8.64
HFO-1336z(Z)	0	2	Exempt	164	2.73	5.46
HFO-1234ze	0	1	Exempt	114	1.9	1.9

Data from US EPA (www.epa.gov/snap) | *Ratio = MW/60, showing extra blowing agent for same density foam. | **Carbon Dioxide equivalents [=GWP * Ratio].

Solubility in Polyols

	ecomate	141b	365mfc	n-C5	c-C5
Caradol 585	**100**	100	32	5	11
Castor Oil	**100**	100	18	47	100
DEG	**100**	35	•	•	•
Ethylene Glycol	**10**	4	3	1	1
Stepanpol 3152	**100**	33	30	6	7
Stepanpol 2352	**100**	30	•	•	•
Terol 256	**100**	10	•	•	•
Arcol LHT240	**100**	100	•	•	•
PPG2000	**100**	100	•	•	•
Jeffol R315X	**100**	100	•	•	•
Voranol 360	**100**	100	•	•	•
Poly G70-600	**100**	75	•	•	•
Multranol 8114	**100**	100	43	9	27

• Not Determined

Materials Compatibility

SEALS

PTFE and Kalrez are the recommended seal materials for neat Ecomate®. EPDM is acceptable. For Polyol/Resin PU systems with ~5% Ecomate®, PTFE, Kalrez, EPDM, Butyl, Viton, Neoprene and Silicone have proven acceptable. Buna-N and Santoprene showed fair results. Isocyanate systems with Ecomate® had similar results to the Polyol/Resin systems. Each PU system is different and it is recommended that compatibility be tested. Consult with an FSI representative for further clarification.

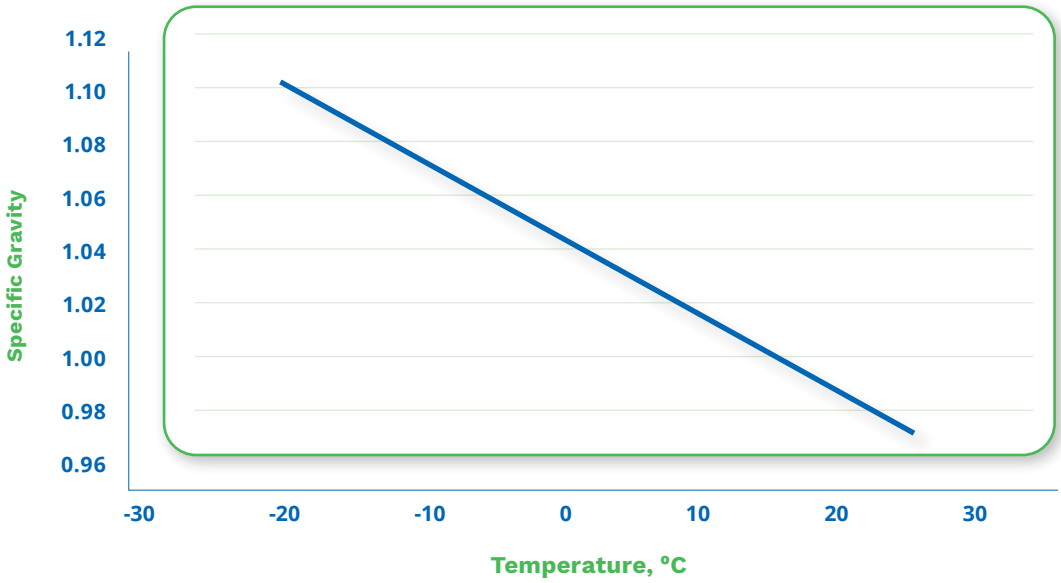
SUBSTRATES AND ADHESION

Ecomate® PU systems have been tested and are currently used with HIPS, ABS, PP, PE, PMMA, PVC, Polycarbonate and other various thermoplastics with favorable results. Compared to legacy PU systems, Ecomate® systems have demonstrated excellent — and in most cases, improved — adhesion to a broad range of plastic, metal and wood substrates.

Miscibility

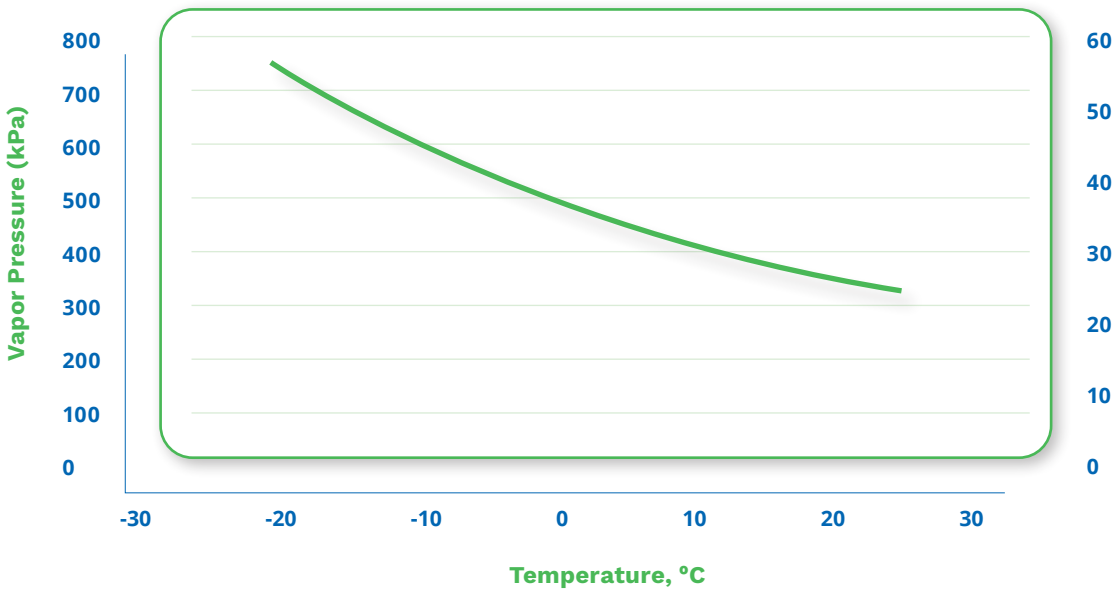
Ecomate® is an extremely miscible blowing agent. Ecomate® is compatible with all current blowing agents, most organic solvents, surfactants, and catalysts.

Technical Data



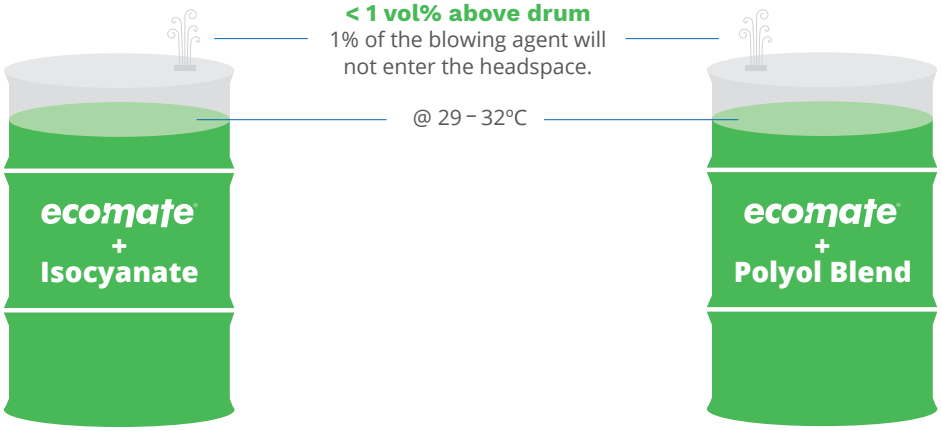
Liquid Density

At 20°C / 68°F the specific gravity is 0.98.



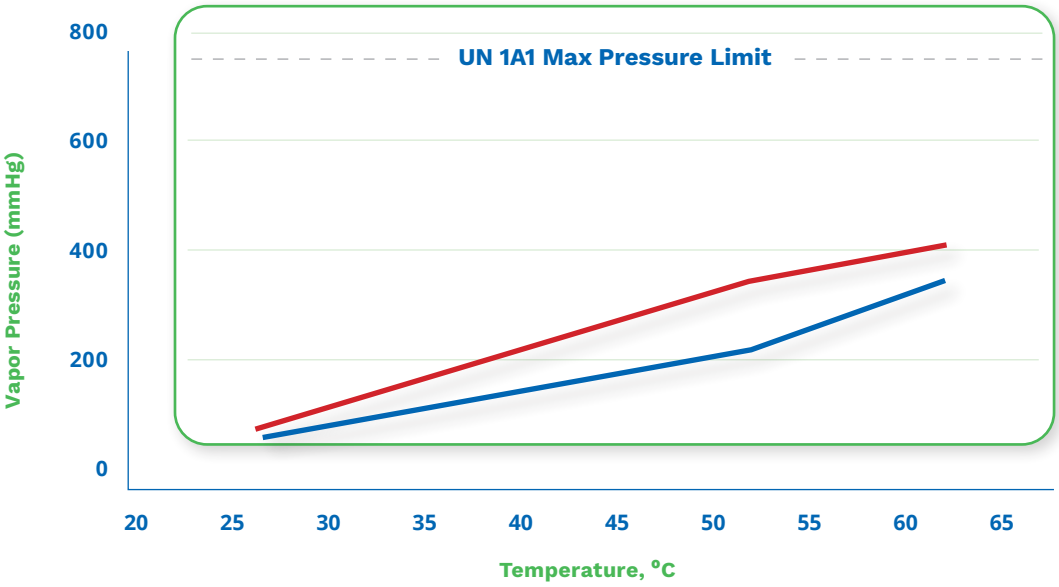
Vapor Pressure of Neat Ecomate®

Ecomate® versus temperature.



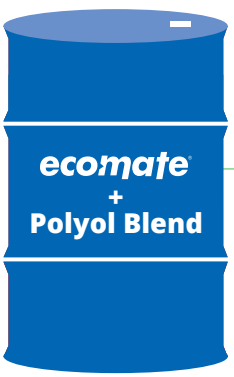
Ecomate® Systems Emissions

Stored systems in drums / totes.



Vapor Pressure of Stored Ecomate® Blends

(ASTM D2879, typical data)
Blowing Agent / Isocyanate



Vapor Pressure Of Stored Ecomate® Blends

(ASTM D2879, typical data)
Blowing Agent / Polyol

Handling and Storage

Thoroughly review the Ecomate® Safety Data Sheet, Technical Data Sheet, and Product Handling Guide before handling the product. Ecomate® can be stored in small containers and larger bulk-type containment. Small containers should be kept in a cool, dry, well-ventilated area. Keep containers closed when not in use and open slowly to allow any excess pressure to vent. Keep away from heat, sparks, flame, or other sources of ignition. Use proper grounding and bonding procedures when loading, unloading, and transferring. Use spark resistant tools and only use dry nitrogen to pressurize containers. Consult an FSI representative for the various options for bulk containment. Chemical stability of Ecomate® is excellent and is similar to that of HCFC-141b. It should not be exposed to strong alkaline compounds or alkali metals. PU formulations have been observed to be stable in excess of six months.

Flammability

Ecomate in its neat form is classified as a flammable liquid. However, when formulated correctly, it is possible to achieve a non-flammable classification for transport.

Lower Flammable Limit (Vol. %)	5.0
Upper Flammable Limit (Vol. %)	23.0
Flash Point (closed cup)	-19°C / -2°F
Auto Ignition Temp	465°C / 869°F
Heat of Combustion (kJ/g / BTU/lb)	-16.2 / 6,965
Min Ignition Energy (mJ / BTU)	0.5 / 4.74 x 10^{-7}

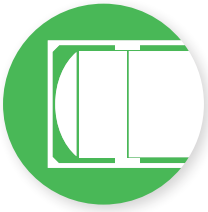
Stability in Solutions

Ecomate® systems, when formulated correctly, are very stable. Unlike other blowing agents, Ecomate® mixes in readily and easily and does not separate like “oil & water” as many other blowing agents do. Blending of Ecomate® does not require sophisticated mixing equipment and/or emulsification equipment and agitators.

Packaging

Ecomate® is available in the following containers.

NON-PRESSURIZED



ISO-TANK

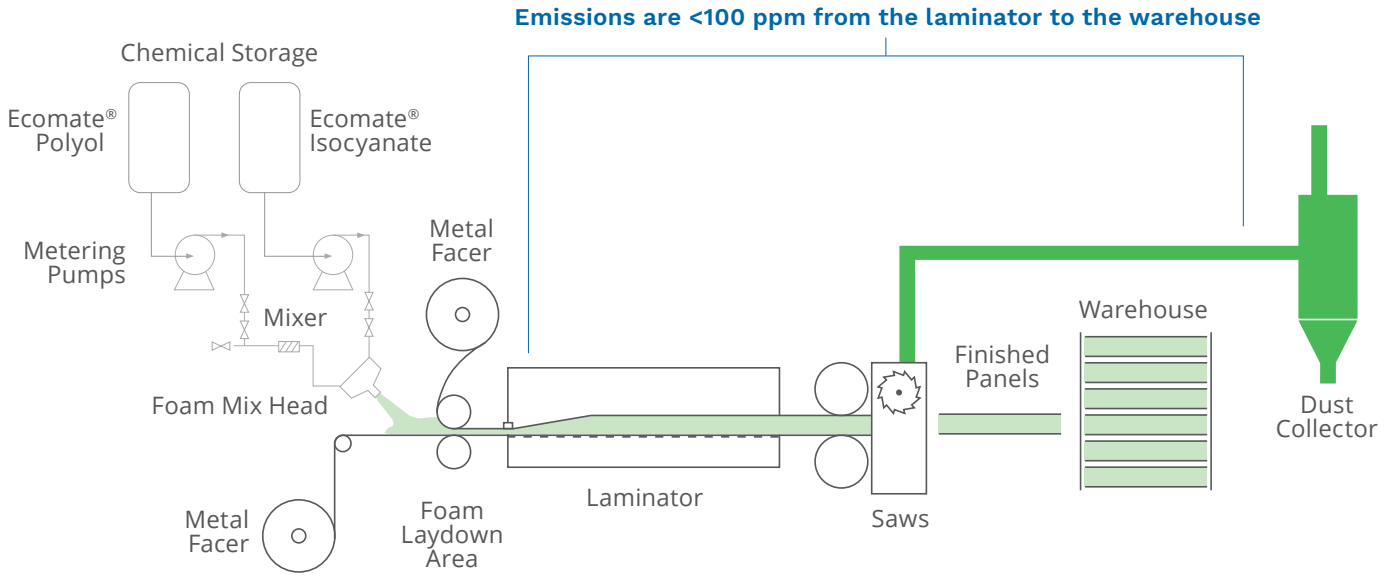
PRESSURIZED

ROADTANKER

Manufacturing Emissions

Because of its excellent solubility, Ecomate® emissions are very low throughout the manufacturing processes, including "3rd-Stream" applications.

Industrial hygiene study measuring manufacturing emissions.



Spray Foam Emissions

Low-pressure spray foam emissions typically release volatile organic compounds (VOCs) and chemicals in parts per million (PPM) concentrations, which are generally lower than those from high-pressure systems but can still impact indoor air quality if proper ventilation is not maintained. Third party emissions and hygiene testing on Ecomate spray systems have proven very favorable.

Low pressure injection equipment

PPM at injection point	600 mm (23.62 in.) from head
2.85	0.59
3.00	0.71
2.95	0.73
2.26	0.63

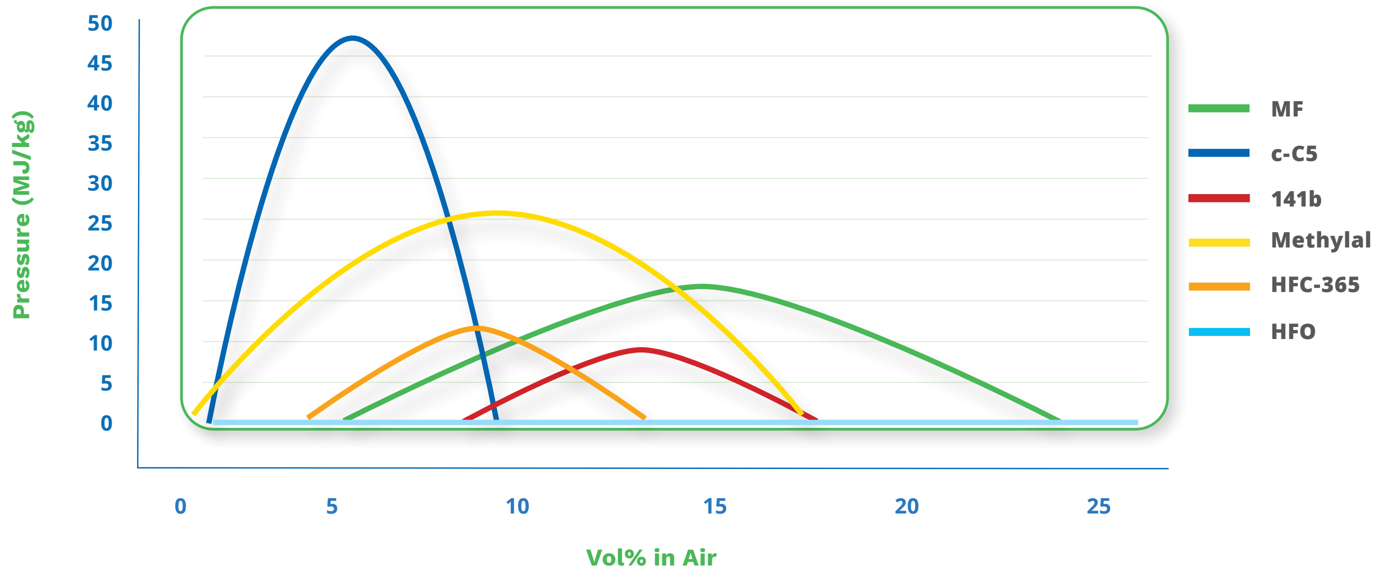
Spray equipment sampling taken indoors ~61 cm (2 ft) from point

PPM over the foaming area	At the spray head
23	10
23	12
20	10

Sample Data below was taken from nominal 25 – 27 kg/m³ (1.56 –1.69 lb/cu³) foam without use of ventilation. Ventilation is a requirement for use of isocyanates.

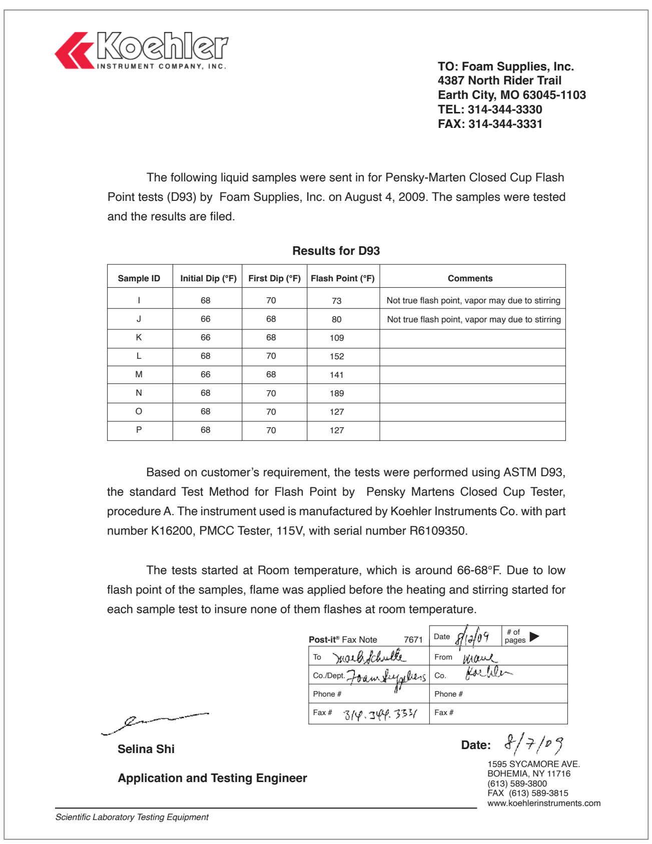
Heat of Combustibility

Historical data (how much energy is expended).



Flash Points and Combustion

When formulated correctly, Ecomate-blown systems have been documented via third party testing agencies to exhibit flashpoints above 38°C/100°F per ASTM D93 while not sustaining combustion as per ASTM D4206.



Koehler
INSTRUMENT COMPANY, INC.

TO: Foam Supplies, Inc.
4387 North Rider Trail
Earth City, MO 63045-1103
TEL: 314-344-3330
FAX: 314-344-3331

The following liquid samples were sent in for Pensky-Marten Closed Cup Flash Point tests (D93) by Foam Supplies, Inc. on August 4, 2009. The samples were tested and the results are filed.

Results for D93

Sample ID	Initial Dip (°F)	First Dip (°F)	Flash Point (°F)	Comments
I	68	70	73	Not true flash point, vapor may due to stirring
J	66	68	80	Not true flash point, vapor may due to stirring
K	66	68	109	
L	68	70	152	
M	66	68	141	
N	68	70	189	
O	68	70	127	
P	68	70	127	

Based on customer's requirement, the tests were performed using ASTM D93, the standard Test Method for Flash Point by Pensky Martens Closed Cup Tester, procedure A. The instrument used is manufactured by Koehler Instruments Co. with part number K16200, PMCC Tester, 115V, with serial number R6109350.

The tests started at Room temperature, which is around 66-68°F. Due to low flash point of the samples, flame was applied before the heating and stirring started for each sample test to insure none of them flashes at room temperature.

Post-it® Fax Note 7671 | Date 8/12/09 | # of pages
To | From
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Fax # 314.344.3331 | Fax #

Selina Shi

Application and Testing Engineer

Date: 8/7/09

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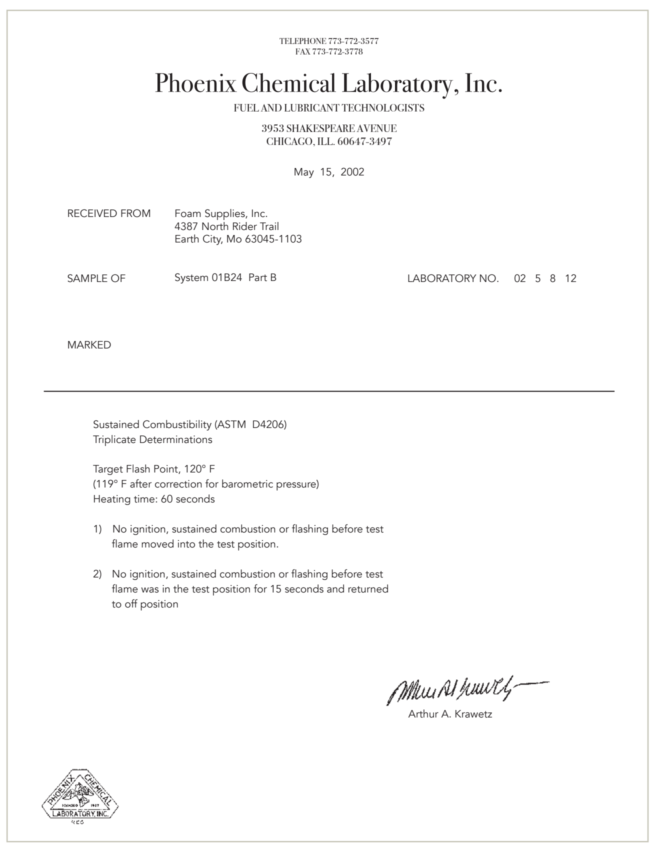
Scientific Laboratory Testing Equipment



TELEPHONE 773-772-3577
FAX 773-772-3778

Phoenix Chemical Laboratory, Inc.

FUEL AND LUBRICANT TECHNOLOGISTS

3953 SHAKESPEARE AVENUE
CHICAGO, ILL. 60647-3497

May 15, 2002

RECEIVED FROM Foam Supplies, Inc.
4387 North Rider Trail
Earth City, Mo 63045-1103

SAMPLE OF System 01B24 Part B LABORATORY NO. 02 5 8 12

MARKED

Sustained Combustibility (ASTM D4206)
Triplicate Determinations

Target Flash Point, 120° F
(119° F after correction for barometric pressure)
Heating time: 60 seconds

1) No ignition, sustained combustion or flashing before test flame moved into the test position.

2) No ignition, sustained combustion or flashing before test flame was in the test position for 15 seconds and returned to off position

Arthur A. Krawetz

PHOENIX CHEMICAL LABORATORY, INC.

Economic Efficiency

In general, it takes the same molar concentration of any blowing agent to blow the same density of foam. There are however two potential mitigating factors of the blowing agent: high volatility (low boiling point temperature) and poor solubility. Both factors will cause more of the blowing agent to escape. Ecomate® combats effects of these factors through its low volatility and high solubility.

Ecomate® has excellent solubility in most polyols and in both sides of A+B systems. It is also soluble with most other blowing agents including HCFC, HFC, HC, HFC and HCFOs. By blending it with the various products available it is easy to customize your product design.

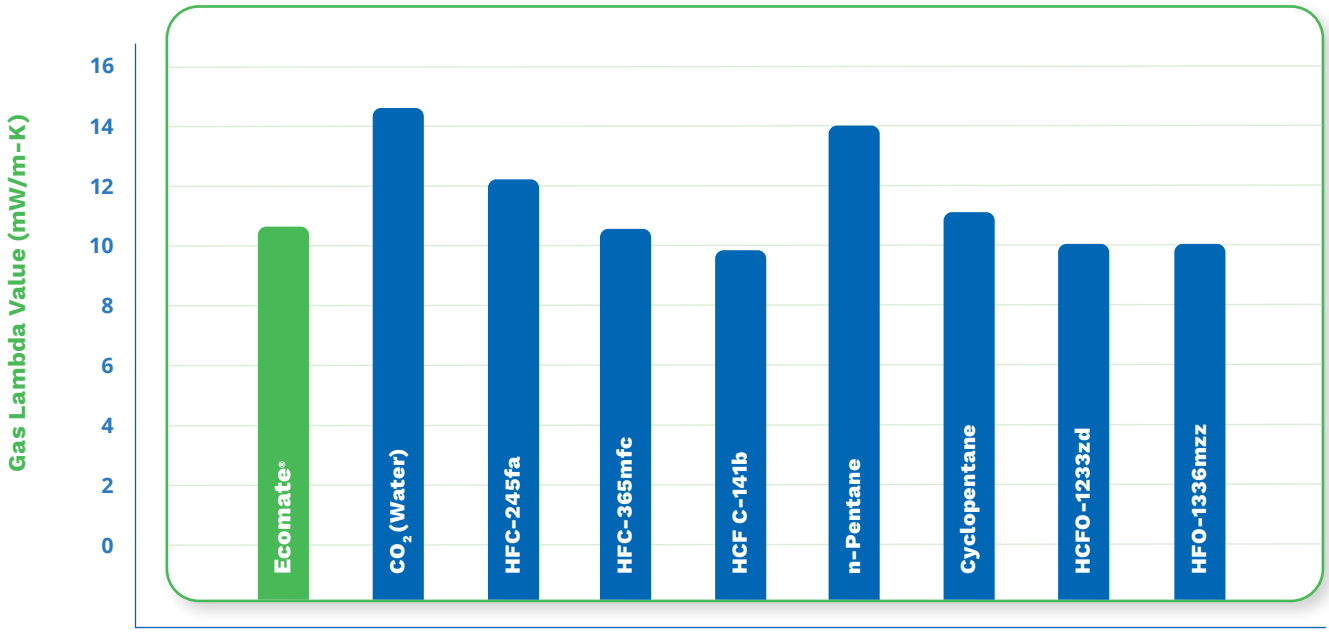
The chart below illustrates how Ecomate® uses less material, and is less expensive at equal density.

Blowing Agent	Relative Price / Weight[1]	Molecular Weight	Weight Factor[2]
Ecomate®	**	60	Ref
HFC-365mfc	****	148	2.47
HCFO-1233zd	*****	130	2.17
HFO-1336mzz	******	164	2.73
n-Pentane	**	72	1.20
Cyclopentane	**	70	1.17

[1] Relative Price per unit of weight [i.e., $/lb or €/kg]. [2] Wt Factor [MW/60] illustrates extra blowing agent necessary for same density foam.

Thermal Efficiency

The low lambda value of neat Ecomate allows production of foams with excellent thermal efficiency. In various side by side comparison tests, Ecomate has proven to perform with comparable outcomes.



ecomate® systems and blowing agent technology is in use around the world.

Ecomate® is available worldwide through our network of global partners. For a complete list, visit ecomatetechnology.com or scan the code below.

fsi.co

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