POLYMATE Ltd.
International Nanotechnology Research Center

PROJECT

NON-ISOCYANATE POLYURETHANE FOAM (NIPF)

Over the years our company has been developing nonisocyanate curable polymer systems and foam materials based on them – Hybrid nonisocyanate polyurethane foam (NIPF).

Thus, in particular, a new kind of cyclocarbonate amine derivatives was developed which are used as curing agents for epoxy compositions. Derived from them hybrid polymeric foam (NIPF) combine the best properties of epoxy and polyurethane systems, but doesn't have major disadvantage of polyurethane foam: high toxicity, since NIPF doesn't use isocyanates.

In NIPF production ,up to 50% of raw materials are from renewable materials (vegetable oils). The uniqueness of the structure and properties of new hybrid systems allows to receive 2K foaming composition in a wide range of physical properties: rigid, semi-rigid, flexible, soft. NIPF also has additional features that extend the range of applications – high fire resistance, chemical resistance, etc.. For NIPF production/application the most of the known techniques can be used (spraying, pouring, injection, molding), and as blowing agents can be used both physical and chemical foaming agents. Foam may be produced in the factory or in on-site.

On base of hybrid nonisocyanate compositions there were developed the foam formulations for various purposes (insulation, packaging, construction, furniture, as well as special-purpose foam).

The development of NIPF is protected by patents pending.

The following presents the properties of some types of our foam.

Table 1. Sprayable NIPF for insulation /construction

Properties	Standard	Value
Viscosity (Brookfield RVDV II, Spindle 29, 20 rpm) at 25^{o}C, cP Part A Part B A+B (3-5 s after mixing)	ASTM D2196	 1500-3000 800-2000 3000-4000
Gel time, s		2-4
Tack free time, s		40-90
Color of cured foam		From white to slight yellow
Compressive Strength, MPa	ASTM D1621	0.2-0.4
Apparent Density, kg/m^3	ASTM D1622	30-40
Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus, ft^2•^{o}F•h/(BTU•in)	ASTM C518	4.5-5.0

Table 2. Pourable NIPF (method "foamed in-a-place") for packaging and construction foams

Properties	Standard	Value
Viscosity (Brookfield RVDV II, Spindle 29, 20 rpm) at 25°C, cP Part A Part B A+B (3-5 s after mixing)	ASTM D2196	 2000-3500 1500-3000 3000-5000
Gel time, min		2-4
Tack free time, min		10-20
Curing for transportation, h		2-4
Color of cured foam		From white to slight yellow
Compressive Strength, MPa	ASTM D1621	0.2-0.4
Apparent Density, kg/m^3	ASTM D1622	30-60
Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus, ft^2•°F•h/(BTU•in)	ASTM C518	3.5-4.5

Table 3. Flexible NIPF (for special purposes)

Properties	Standard	Value
Viscosity (Brookfield RVDV II, Spindle 29, 20 rpm) at 25°C, cP Part A Part B A+B (3-5 s after mixing)	ASTM D2196	 1500-2000 1000-2500 2500-3000
Gel time, min		2-4
Tack free time, min		~20
Color of cured foam		From white to slight yellow
Hardness, Asker, F scale	TBD	65-80
Density, kg/m^3	ASTM D3574	30-40
Tensile Elongation, %	ASTM D3574	100-140

The proposed hybrid NIPF based on epoxy resins and nonisocyanate urethanes is the alternative to conventional 2K polymeric foam.

By combining inside NIPF both epoxy resins and nonisocyanate urethane components, and also derivatives of natural oils, elaborated foam combines all basic properties of epoxy and urethane foams – high strength together with a low density and doesn't have the inherent toxicity of polyurethane.

Polymate Ltd. may offer to potential consumer development of foam with other specific properties in accordance with customer requirements.