

Spray Foam Opportunities and Challenges and..10 things you need to know.



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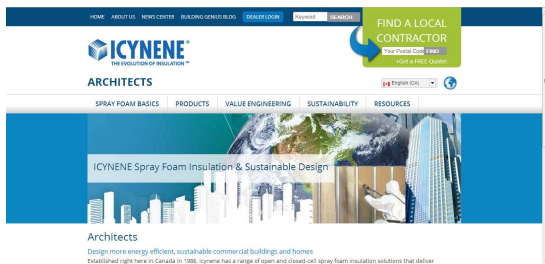
Icynene Inc.

- Manufacturing operations located in Mississauga, ON
- Distributed in Western Canada by Shoemaker Drywall Supplies
- Icynene Classic (LD-C-50) was invented in Canada
- Icynene was incorporated in 1986
- Icynene product portfolio includes low-density and medium-density (water blown and blowing agent) spray foams
- Distributors / contractors in 30+ countries globally

**Icynene is celebrating...
30 years in business this year!**



Icynene.com



Dedicated Canadian Team

- Sales Director
- Territory Managers
 - Western Canada
 - Eastern Canada
- Architectural/Commercial Sales
- Technical Services Representative
- Engineering Support: 3 in Canada



Our Partners



6 Laws of Building Science

Eventually:

1. All concrete cracks
2. All steel rusts
3. All wood rots
4. All foundations settle
5. All windows leak
6. Always good to have friends in the practice of law



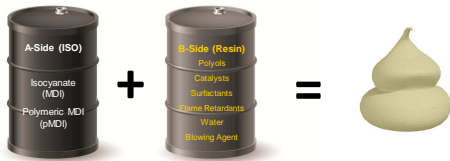
Agenda

- Introduction to SPF chemistry
- Advantages and applications
- Challenges
- Standards and Quality Assurance
- Project Examples
- 10 Things You Should Know..



What is spray foam (SPF)?

Liquid components that are sprayed or poured in place that **expand** into a polyurethane cellular plastic foam



Spray Foam Types

Low Density

- Open Cell
- Soft, flexible foam
- Not a vapour barrier at any thickness



Medium Density


- Closed Cell
- Hard, rigid foam
- Vapour Barrier at 50 mm thickness



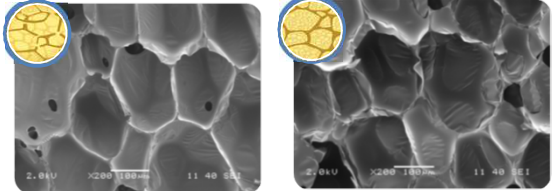
Spray Foam Types

<ul style="list-style-type: none">• Soft, flexible foam• 0.5 lb., 0.75 lb., "1" lb. / cu. ft.• Water as blowing agent• Open Cell• R 3.5 – 4.3 per inch• Permits drying• Allows water to drain• Air barrier material• Thicker passes	<ul style="list-style-type: none">• Hard, rigid foam• Two pound (2 lb.) / cu. ft.• Captive blowing agent• Closed Cell• LTR (min. 1.8 RSI for 50 mm)• Barrier to vapour• Barrier to bulk water• Air barrier material• Passes limited to 50 mm (maximum)
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Low Density Medium Density



Under the Microscope





_____ - Cell _____ - Cell



SPF Types – The Rest of the Story..

Low Density <ul style="list-style-type: none">• High expansion (80 to 1 or more)• Spray in one pass• Easy to trim• Full fill / scarf off excess in cavities if required	Medium Density <ul style="list-style-type: none">• More controlled expansion (30 – 40 to 1)• Spray in multiple passes• Difficult to trim• Typically under-fill cavities to avoid trimming
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Spray Foam Evaluations

Low Density

Medium Density

- Both can be Evaluated by CCMC
 - Standardized materials: Evaluation Listing
 - *Companion Installation standard must have been published*
 - Novel materials: covered by an Evaluation Report to a Technical Guide
- Both must be installed by trained and certified installers



Installation Equipment



Code Requirements Satisfied

- Thermal Protection
- Air Leakage Control
- Vapour Diffusion Control (ccSPF)
- Protection Against Wind-Driven Rain (ccSPF)
- Protection Against Surface and/or Ground Water (ccSPF)
- Sound Transmission Control (ocSPF)



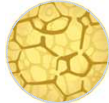
Advantages of Open Cell

- Low Density Open Cell foams are soft and flexible
- Compatible with most building products
- Generally will not absorb bulk water unless under hydrostatic pressure (grade / supplier dependent)
- Greater sound attenuation vs. a rigid foam
- High "yield" (board feet per drum set)



Open Cell Spray Foam

- Evolving standardization: CAN/ULC:
 - S712.1: (material; published)
 - S712.2: (installation, expected late 2016)
- CCMC Evaluation Reports available
- Used within the building enclosure or protected from weather
- Very little compressive strength
- NOT A VAPOUR BARRIER!
- Can be applied at large pass thicknesses (up to 300 mm possible)



Applications

Complex Construction



- Facilitates air barrier continuity
- Foam expands into/around structural elements

Cantilevers

- Floor sheathing provides vapour barrier on interior
- Thermal barrier required in garage
- Services kept within the heated boundary



Applications

Basement walls



- Thermal barrier required (ie. 12.5 mm gypsum board)
- Vapour barrier required
- Damproofing required

Crawlspaces

- Thermal barrier may be required if other than *concealed* space
- Thermal barrier may be required (if used as a return air plenum or height > 1.8 m.)



Applications

Sills & Headers

- Thermal barrier required
- Vapour barrier required



Exterior walls

- Thermal barrier required on interior
- Vapour barrier required



Applications

Floor of Attic



- High R-values required
- Vapour Barrier required
- Flexibility beneficial (truss uplift)

Unvented Attic ("Hot Roof")

- Thermal Barrier required if occupied space or cathedral ceiling
- Vapour Barrier required
- Venting required?



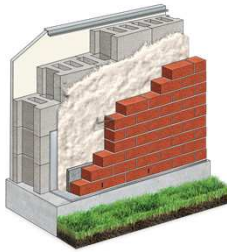
Advantages of Medium Density



- Air Barrier material
- Vapour barrier: at 50mm
- High RSI (R)-value (LTTR* at 50 mm):
 - Type 1: RSI 1.8 to 2.0,
 - Type 2 : > / = RSI 2.0
- Adheres to most common building materials
- High compressive strength ie. under slab
- Continuity of application: monolithic application
- Install to any total thickness; passes of 15 to 50 mm.



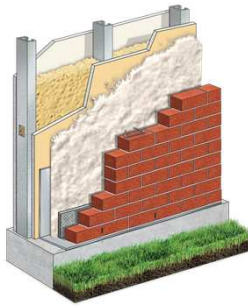
Continuous Insulation



Continuous Insulation



Cavity + Continuous Insulation



Challenges for SPF

Challenge

- Fire testing and combustibility
- VOC's
- Blowing agents and environmental impact
- Product stewardship

Solution

- Material and assembly fire tests
- VOC testing (with review)
- Water blown formulations, new blowing agents
- Installer Certification / QAP



Challenges for SPF

- Higher Code-required RSI values:
 - Prescriptive values difficult with cavity insulation alone
 - Is thermal bridging dealt with?
- Building energy reduction:
 - Via RSI-value or airtightness or both?
- Hybrid (SPF/fibre) assemblies: may be problematic
- Prescriptive vapour barrier vs. assemblies that can dry
- Approval process for innovations
 - Material
 - Applications ie. unvented roof / attic spaces



VOC's


- CAN/ULC S774:
 - required testing for an SPF product seeking any type of CCMC evaluation
 - may also include a toxicological review

5.5.10 Volatile Organic Emissions

5.5.10.1 For formulations intended for use in inhabited spaces, the volatile organic compound emissions from applied cellular plastic are to be tested and health hazards evaluated in accordance with the appropriate methods in CAN/ULC-S774.

5.5.10.2 The volatile organic compound emissions shall be determined and their health hazards evaluated in accordance with the appropriate methods selected by following the guidelines in CAN/ULC-S774.



5.5.10.3 The volatile organic compound emissions for cellular plastic shall not exceed the limits stated in Table 2.




VOC's


Third Party Testing (label):
- not required but becoming common, ie.

- UL Environment
 - GREENGUARD
 - Standards to certify products for low chemical emissions
- "California CDPH" testing
 - a.k.a. Spec. Section 01350
 - Often associated with rating systems: LEED, GreenGlobes, CHPS







Sustainability



- LEED Credit contribution potential:
 - consult manufacturer
- Recycled content, renewable content
 - Consult manufacturer
- Custom fit material with minimal waste
- drums can be re-conditioned or recycled
- Zero-Ozone-Depletion Potential (ODP) blowing agents
- Low Global Warming Potential (GWP) blowing agents
- Reduced transportation impacts (to site)
- Contribution to sealing building enclosure:
 - more energy-efficient building operation



Quality Assurance



S705 – Standard in Canada for Medium Density SPF

- CAN/ULC S705 series: (with any Amendments)
 - .1 = **Material**: performance, physical properties, identification, etc.
 - .2 = **Application (Installation)**: equipment, site conditions, substrate preparation, testing documentation, waste handling, etc.
 - .3 = **Design**: (reserved for future)
- CCMC Listing is proof of compliance with code clauses
 - Refers to a Code Edition
- Products must have means of identification (usually colour)



S705.1- Material Requirements

- Density: Minimum 28 kg/m³
- LTTR - Minimum of RSI 1.8 @ 50 mm ("Type 1")
- Flame Spread - Maximum of 500
- Air Permeance (material) - Maximum 0.02 L/s.m²
- Tensile Strength - Minimum of 200 kPa (29 psi)
- Compressive Strength - Minimum of 170 kPa (25 psi)
- Dimensional Stability - Maximum -0 / +14% (@70 C / 97 % RH)
- Water Absorption - Maximum 4%
- Vapour Permeance - Maximum 60 ng (1 perm)
- VOC: time to reoccupancy – Max 30 days



Quality Assurance

- **At Job Site (by Installers)**
 - Density Testing, Adhesion Testing, Cohesion testing
 - Daily Work Record
 - Job Site Label
- **At Factory (possibilities)**
 - ISO 9000
 - Follow-up service agencies (listings: periodic inspections)
- **QAP**
 - Training and licencing of installers (personnel certifier)
 - Auditing training
 - Site inspections



QAP Requirements



Icynene QAP

- Provided by Morrison Hershfield
 - 13 offices across Canada
 - Bilingual services
 - Associated building enclosure practice
 - Provide technical support as well as QAP
- Installers are trained, evaluated and are issued ID cards



Protection of Foamed Plastics

Code Language:

- “...foam plastics...shall be protected from adjacent space by any thermal barrier meeting the requirements of 9.10.17.10 (3.1.5.12.(2)(e))”
 - Prescriptive:
 - Gypsum board, plaster, various wood panel products, sheet metal, etc.
 - Products meeting CAN/ULC S124 (3.1.5.12.(2)(e)):
 - cementitious-based (thick coatings)
 - some fibre products
 - some coatings (Alternative Solution)



Emerging Code Trends

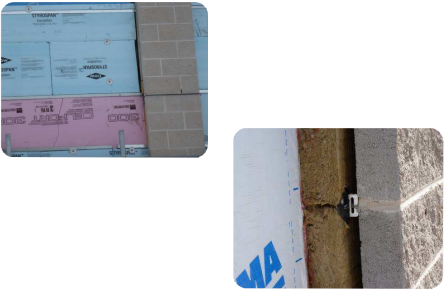
- Energy:
 - NECB (ASHRAE 90.1)
 - Medium Density SPF provides a high performance economical solution to:
 - Continuous Air Barrier
 - Continuous Insulation (permanent & substantial contact)
 - **Reduces thermal bridging, higher effective R-Value of wall**



Continuous Insulation – Can Achieve This



Continuous Insulation – Avoid This

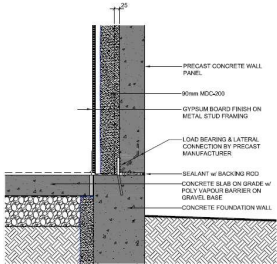


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The Evolution of Insulation

Project Examples

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Precast with Stud Wall

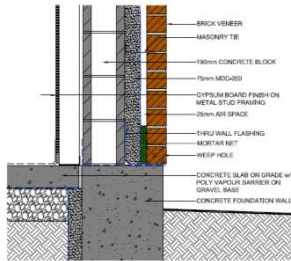


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Example – Steel Stud Wall



AVB / Masonry Cavity Wall, CMU



AVB / Masonry Cavity Wall, CMU



Below Slab on Grade

CONCRETE FOUNDATION WALL ON CONCRETE STEP FOOTING WITH WATERPROOF MEMBRANE

WEEPING TILE WITH GRAVEL COVER

30mm or Thicker MEMBRANE APPLIED DIRECTLY TO GRAVEL BASE

CONCRETE SLAB ON GRADE ON 150mm GRAVEL BASE

Below Slab on Grade

Backpan Insulation

Backpan Insulation



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10 Things You Should Know..

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ocSPF is an Air Barrier

- Meets usual material criteria of less than 0.02 L/s.m² at 75 Pa
- Check:
 - At what thickness?

ICYNENE Classic™

PERFORMANCE CHARACTERISTICS AND AIR BARRIER PROPERTIES

Product Description: ocSPF is a polyurethane foam insulation system that is applied in place and cures to form a rigid, closed-cell foam. It is used for exterior wall and roof insulation.

PHYSICAL PROPERTIES

Property	Value	Test Method
Density	0.025 to 0.035 g/cm³	ASTM D 2856
Thickness	100 to 200 mm	ASTM D 2856
Compressive Strength	0.1 to 0.2 MPa	ASTM D 1621
Flexural Strength	0.1 to 0.2 MPa	ASTM D 726
Tensile Strength	0.1 to 0.2 MPa	ASTM D 726
Elongation at Break	10 to 20%	ASTM D 726
Modulus of Elasticity	0.1 to 0.2 MPa	ASTM D 726
Impact Resistance	10 to 20 J/m²	ASTM D 2641
Water Absorption	Less than 1% after 24 hours	ASTM D 570
Water Vapor Diffusion Coefficient	Less than 0.001 m²/s	ASTM E 96
Permeability Coefficient	Less than 0.001 m²/s	ASTM E 96
Air Permeability	Less than 0.02 L/s.m² at 75 Pa	ASTM E 2178
Fire Resistance	Classified according to applicable standards	ASTM E 84
Acoustic Properties	Classified according to applicable standards	ASTM E 90
Adhesion	Classified according to applicable standards	ASTM D 1004
Chemical Resistance	Resistant to most acids, alkalis, and solvents	ASTM D 1535
UV Resistance	Resistant to UV radiation	ASTM D 4328
Temperature Resistance	Operational from -40°C to 120°C	ASTM D 2856
Flammability	Classified according to applicable standards	ASTM E 84
Smoke Density	Classified according to applicable standards	ASTM E 84
Weighted Average Sound Absorption Coefficient	Classified according to applicable standards	ASTM E 105
Sound Absorption Coefficient	Classified according to applicable standards	ASTM E 105
Sound Reflection Coefficient	Classified according to applicable standards	ASTM E 105
Sound Transmission Loss	Classified according to applicable standards	ASTM E 90
Sound Transmission Class	Classified according to applicable standards	ASTM E 90
Impact Sound Pressure Level	Classified according to applicable standards	ASTM E 1417
Footfall Sound Pressure Level	Classified according to applicable standards	ASTM E 1417

Canada

INDUSTRIAL PROPERTIES

ocSPF is a polyurethane foam insulation system that is applied in place and cures to form a rigid, closed-cell foam. It is used for exterior wall and roof insulation.

ENVIRONMENTAL PROPERTIES

ocSPF is a polyurethane foam insulation system that is applied in place and cures to form a rigid, closed-cell foam. It is used for exterior wall and roof insulation.

ENVIRONMENTAL MECHANICAL OPERATION

ocSPF is a polyurethane foam insulation system that is applied in place and cures to form a rigid, closed-cell foam. It is used for exterior wall and roof insulation.

WATER AND WATER VAPOR PROPERTIES

ocSPF is a polyurethane foam insulation system that is applied in place and cures to form a rigid, closed-cell foam. It is used for exterior wall and roof insulation.

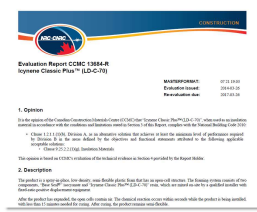
FLAME CHARACTERISTICS

ocSPF is a polyurethane foam insulation system that is applied in place and cures to form a rigid, closed-cell foam. It is used for exterior wall and roof insulation.

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ocSPF has CCMC Reports

- Is an opinion
- Is an Alternative Solution
- However, many legacy Reports go back 10-20-30 years



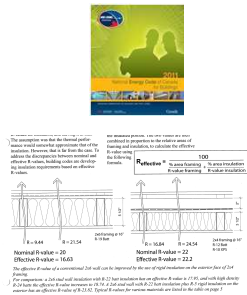
ocSPF is becoming standardized

- S712.1(material)
 - First published 2010
 - Latest Edition 2016
- S712.2 (installation)
 - Expected late 2016 (?)
- When will appear in NBC?



Effective RSI-value: can use actual

- ccSPF
 - The Table values are conservative
 - SPF: reflect the minimum LTTR requirement
 - Use actual tested value:
 - Up to 10% greater thermal resistance possible



There is a Standard for QAP

- All QAP providers must follow this ULC Standard
- It is not referenced in the Building Code
- Provider may be asked to confirm, by CCMC



Look up SPF contractor/installer credentials

- mhqap.com
- cufca.ca
- foamexperts.ca



Beware US test data

- Clues:
 - ASTM E84 for flame spread
 - Small numerical values
 - No LTTR for ccSPF
 - No colour declared for ccSPF
 - No metric units
 - Page 1 inconsistent with Page 2
 - FR doesn't match EN

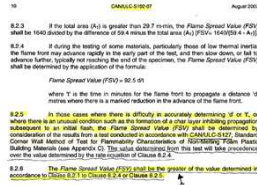


CCMC CERTIFICATION PROGRAM



Flame Spread: S102 or S127?

- Code criteria:
 - Less than 500
 - Often see both on a data sheet
 - The numerically greater value must be used



ccSPF: Crowded Colour Space

- Many manufacturers
 - Credit: Materials assembled by Exova
- Colours fade quickly
- Should use other means to confirm:
 - Daily Work Record
 - Job Site Label



CAN/ULC S705.1: no Types (2015)

- "Typing" often appears in project specifications
- Only remaining criteria:
 - For LTTR (50 mm):
 - not less than 1.80



Foamed Plastic to Ductwork

- Effective NBC 2015
 - When stated conditions are met
 - Some jurisdictions allowing now as an Alternative Solution

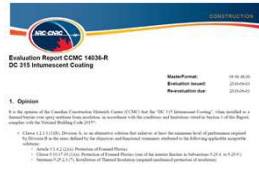
6) Foamed plastic insulation conforming to Article 9.25.2.2, is permitted to be used to insulate a galvanized steel, stainless steel or aluminum air duct, provided

- a) the foamed plastic insulation applied to supply ductwork is not less than 3 m from the furnace burner,
- b) the temperature within the ductwork where the insulation is installed is not greater than 50°C,
- c) duct joints are taped with a product conforming to Sentence 9.33.4.3.(1),
- d) return air plenums are separated from the foamed plastic insulation, and
- e) the foamed plastic insulation is protected
 - i) by one of the interior finishes described in Subsections 9.29.4. to 9.29.9,
 - ii) provided the building does not contain a Group C major occupancy, by sheet metal that is mechanically fastened to the supporting assembly independent of the insulation, is not less than 0.38 mm thick and has a melting point of 650°C or more, or
 - iii) by any thermal barrier that meets the requirements of Clause 3.1.5.15.(2)(e).



Thermal barriers: Alternatives

- Some products do comply with the prescriptive criteria (S124 test):
 - Thick coatings (several)
 - Mineral fibre (x2)
 - Thin coatings (x1)
- Any CCMC report:
 - An alternative solution
 - Read Scope and Limitations carefully



SPF and soil gas barrier?

- No materials referenced in NBC 2015 9.13.4.2
- No tests referenced for soil gas barrier material
 - However, is under study
- Solution:
 - Provide an air barrier system

9.13.4.2. **Division B**

9.13.4.2. **Protection from Soil Gas Ingress**

1) All walls, roof and floor assemblies separating conditioned space from the ground shall be provided with an air barrier system conforming to Subsections 9.13.4.3 to 9.13.4.5.

2) Unless the space between the air barrier system and the ground is designed to be suitable for the above installation of a subfloor depressurization system, building units and buildings containing residential occupancy shall be provided with the strength for a water-resistance system conforming to Article 9.13.4.5.

3) Where buildings are used for occupancy other than those described in Sentence 2), protection from radon ingress and the means to achieve high radon concentrations in the future shall conform to:

- a) Article 9.13.4.4, or
- b) Article 9.13.4.5.

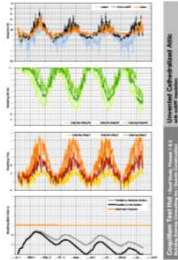
(See Note 9.9.13.4.2.(1)).

9.13.4.3. **Providing for the Rough-in for a Subfloor Depressurization System**
(See Note 9.9.13.4.2)



Invented Roofs Can Work

- Studied roof/attic spaces in a “test hut” scenario
 - Instrumented
- Climate Zone 4/5



Invented Roofs Can Work

- Opened up actual installations
- Low “mould index”
- No damaging moisture content
 - Instrumented
 - Measured
 - Visual



SPF Summary

- Opportunity to simplify construction and meet Code with a material that serves multiple functions, control of any / all of:
 - Heat flow
 - Air flow
 - Moisture (bulk)
 - Moisture (vapour)
- More mainstream use of SPF, moving beyond solving specific problems
- SPF is a thoroughly tested material
- Third-party oversight of training and Quality Assurance process



Thanks for Your Attention

Questions / Discussion



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