ASHRAE Anthracite Chapter

The Anthracite Chapter

NEWS

April 2022

ASHRAE - Shaping Tomorrow's Built Environment Today

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President's Message

Hello ASHRAE members and friends.

Thank you to all that participated in the election of our chapter officers for next year. And thank to our new officers for your willingness to serve our chapter.

Summer will be here before we know it. Continue to round up your foursomes for this year's Mark A. Hagan, PE Memorial Golf Outing at Blue Ridge Trail Golf Club. Hopefully, we will have beautiful weather and a great day.

Thank you to member Nicola Pilone for this month's technical article! The article is included in our News and Notes section.

Our meeting this month will be at Sand Springs Country Club in Drums. Please see page 2 for meeting information.

A couple of notes:

- We have strived to keep the cost of attending our monthly chapter meetings at $30.00 as it has been for many years. With the rising costs this year we have struggled to find venues that fit into this budget and the chapter has been losing money holding the meetings. In order to continue we must increase the cost of the meetings to $35.00.
- Anyone who would like to play a round of Golf next Tuesday at Sand Springs can get a discounted round of golf at the course. Tee times must be made prior to Tuesday and you will need to mention that you are with the ASHRAE group dinner that evening.

Thank you for your continuing support of ASHRAE and the Anthracite Chapter,

Michael Mecchi
Anthracite ASHRAE President 2021-2022

Chapter Website: http://anthracite.ashraechapters.org

ASHRAE ANTHRACITE CHAPTER MEETING

Tuesday April 19, 2022

THE EXCEPTIONAL ADVANTAGES OF USING SHELL & COIL VERTICAL HEAT EXCHANGERS FOR GENERATING HEATING HOT WATER AND DOMESTIC HOT WATER FROM STEAM.

Presented by

Rick Kobylinski

-The presentation will show how counterflow sub-cooling shell & coil heat exchangers use less steam to generate the same heat load as shell and tube heat exchangers. This can reduce your carbon footprint and actually give end users a **Return On Investment** when installing a HX skid with a shell and coil HX and V Ball control valve technology.
-These HXs are of a fully welded 316L vertical construction that provides a very robust and long-lasting skid (no leaking tubesheets to replace) in a smaller footprint.
-V Ball technology control valves and actuators provide a 300:1 turndown for very accurate temperature control and can accept from as little as 6# steam pressure and as high as over 100# steam pressure without the necessity for a PRV station to reduce steam pressure.
-For locations where condensate is not returned to the boiler but must be sent to drain, the domestic hot water heat exchangers can sub-cool the HX condensate to 130 F or lower to allow end users to send the condensate to drain. No water-wasting quench hoses or condensate coolers are needed to get the condensate temperature down below 140 F to allow condensate to be piped to drain to satisfy municipal plumbing codes.
-Sub-cooled condensate eliminates the danger of flash steam in your skid system and extends the life of your condensate receiver / pump seals. That means lower maintenance costs.
-Case histories are available.
-Questions are welcomed during and after the presentation.

Rick is currently the Product Manager / Technical Consultant at Cooney Coil & Energy, Inc. in King of Prussia, Pa.
-Former Steamfitter / Pipefitter from 1971 – 2012.
-Owner / Operator of R.S.K Mechanical Contractors from 1992 – 2012 (In-House Contractor at GlaxoSmithKline Pharmaceuticals at their Upper Merion and Upper Providence R & D Sites).
-Outside Sales, Product Development & Patent Procurement at Cooney Coil & Energy for Cooney Freeze Block HVAC coils starting in January 2013.
-Product Development of Cooney Thermo-Packs (Steam to Hot Water Shell & Coil HX Skids) starting in 2019 with initial multiple skid installations at Cornell University and Temple University projects.

A Certificate of Attendance will be emailed to attendees

Location: **Sand Springs Country Club**
10 Clubhouse Dr, Drums, PA 18222
(570) 788-5845

Schedule:	5:00-5:45 p.m.	Business Meeting (All are Welcome)
	5:30-6:30 p.m.	Social Hour (Cash Bar)
	6:00-6:30 p.m.	Dinner/Program Registration
	6:30-7:15 p.m.	Dinner (Buffet)
	7:15-8:30 p.m.	Announcements & Presentation

Cost: $ 35.00 cash or check / $ 37.00 credit card / FREE for Students

Only If You Are Planning to Attend Please Respond by 2 pm on FRIDAY April 15, 2022
to Michael Mecchi at (610) 674-3326 or via e-mail at c134@ashrae.net

NEWS and Notes

Membership News

New Chapter Members

Please welcome the newest members to our chapter: Amanda Hall, Johnson Controls, and Brock Shemory, Benell Inc. Welcome Amanda and Brock to the Anthracite Chapter!

Chapter Officers Elected for 2022-2023 Society Year

The election results are in and the chapter officers for next year are:

President – Ron Sibulsky
President-Elect – James Pensyl
Vice President – Seth Kunkel
Treasurer – Michael Mecchi
Secretary – Nicola Pilone
Board of Governors – Linda Montville, Chris Amico, Phil Latinski

A big THANK YOU! to all that have committed to serve.

2022 Mark A. Hagan, PE Memorial Annual Golf Outing

NEWS and Notes

CRC (Chapters Regional Conference) 2022

Our CRC committee has been working hard to make this year's event spectacular. Look for registration information, sponsorship opportunities, and more coming soon.

SAVE THE DATES

ASHRAE Anthracite Chapter

2022 ASHRAE Region III CRC

August 18, 19 and 20, 2022

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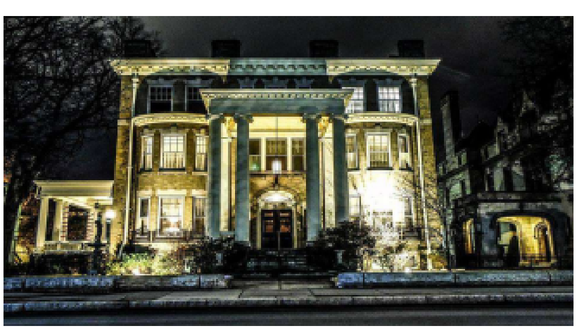


NEWS and Notes

Technology Corner

INTRODUCING NANO TECHNOLOGIES INTO POLYMERS FOAM MANUFACTURING

Author: Nicola Pilone
Date: 1 Feb 2022

The article presents the results and findings of a research study carried out by the Author in the early 2000's investigating the potential use of nano particles to improve, and make more sustainable, the production of Polyethylene foams. With an ever-increasing focus on environmental responsibility, the use of nano particles presents good promise and as such interest in additional research is expected to grow.

About the Author

Nicola Pilone is the president of PT Tubes Inc. a manufacturer of in the field of pre-insulated copper tubes located in Carbondale, PA. In addition to being a seasoned entrepreneur, he holds a master's degree in Mechanical Engineering and is active in researching new and improved manufacturing processes.

Nicola is a member of several industry organizations including:
• ASHRAE, The American Society of Heating, Refrigerating and Air Conditioning Engineers
• ASTM, American Society for Testing and Materials
• ASME, the American Society of Mechanical Engineers

Nicola PILONE is active as the chair of multiple tasking groups at the ASTM under the committee "Copper and Copper Alloys" and the sub-committee "Pipe and Tube"

Introduction

The present article intends to share the outcome of some research studies carried by the Author that displayed very interesting results from use of nano particles in Polymer foams production.

The idea to use nano particles for Polymer foams production is fairly new, since till the end of Last Millennium, Industry had a very solid set up for producing Polymer foams by means of Chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs).

It is a fact that foams from such process had proven to have extremely positive features, nonetheless the findings of the effects of CFCs and HCFCs gases on the ozone have driven the the Kyoto agreement (signed in 1997 and in force from 2005) to rightly ban the use of such gases and hence dispose of this solution.

The industry has then explored for alternatives and found the best in terms of quality of the foams in Hydrocarbons, mainly Isobutane or similar.

Further alternatives have been found in more eco-friendly solutions like Nitrogen, extremely safe as inert gas, or Carbon Dioxide and/or mixture of the above.

Apart of the cost of feedstock that might not defer drastically, the use of these gases would have an important economic impact also in terms of Capital and Operating costs for the Processing plants, since there would be an important simplification, waiving the necessity of the infrastructures and protocols necessary to handle extremely hazardous gases as isobutane or similar.

Unfortunately, with the current state of the art of the relevant technology, none of the above-mentioned gases has allowed by themselves producing foams of the same features as those produced by means of CFC and HCFC gases in the past and mainly Isobutane in the last couple of decades.

The scope of the research presented in this article is to fill specifically this gap, leveraging on the use of some specific additives.

More in details (and where the main novelty of the research relies) such addition of these extra compound has proven to be extremely more effective when the compound had been prepared at size of nanoparticles, since, only in this fashion, an intimate inclusion of the additive within the polymer mold could take place, sensibly impacting the characteristics of the overall mold and hence the features of the final foam.

Background

Indoor well-being is granted by means of advanced air conditioning systems that allow accurate control of temperature and humidity in our premises, assuring the most adequate and healthy environment for human beings.

Such effort comes at a cost in terms of energy consumption and, as of today, air conditioning accounts for about 18% (*) of the total US Energy Consumption.

These figures burden us with the responsibility to strive to reduce the energy consumption associated with Air Conditioning.

This effort would benefit our domestic economy and have a direct impact on reducing emissions and meet the challenging targets that the International scientific Community is setting to safeguard the future for our children.

Main leverages that we have to reduce energy consumptions are progress in the automation and control of the systems (out of scope of the present article) and insulation of the tubing conveying the fluids for thermal exchange.

As a matter of practice, the copper tubes connecting the indoor to the outdoor are usually referred to as line set and have the below composition with a thick layer of insulation (item 3 in the picture below) wrapping the copper tube conveying the fluids.

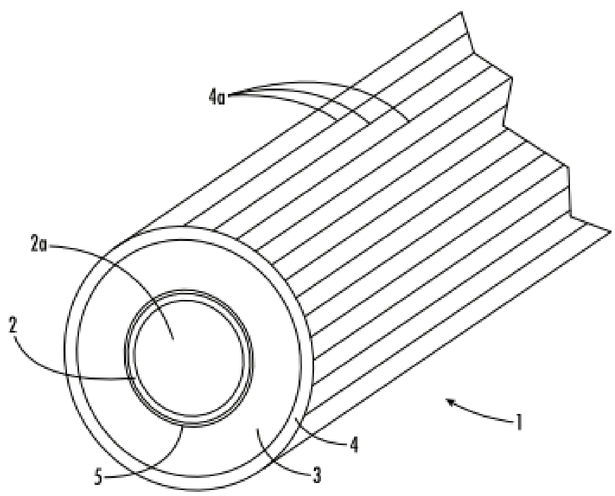
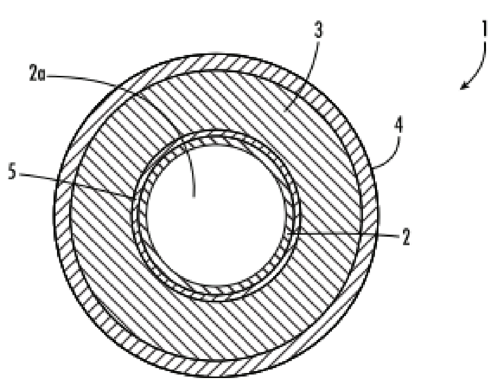


FIG. 1



(*) data from EIA website

The quality of the insulation affects the magnitude of the fraction of the thermal energy generated by the HVAC+R equipment positively transferred indoor rather than wasted to the outdoor.

The industry has historically consolidated the use of polymers foams.

The advantage of foams is that the shape of the foams grants a much more effective insulation rather than the base polymer.

Referring to table below, foams have a thermal conductivity on average ten times smaller than the solid polymers from which they are derived.

THERMAL CONDUCTIVITIES AND DIFFUSIVITIES

Material	Thermal conductivity, (W/m K)	Thermal diffusivity, a (m^2/s)
Copper (solid)	384[a]	8.8×10^{-5} [a]
Aluminium (solid)	230[a]	8.9×10^{-5} [a]
Alumina (solid)	25.6[a]	8.2×10^{-6} [a]
Glass (solid)	1.1[a]	4.5×10^{-7} [a]
Polyethylene (solid)	0.35[a]	1.7×10^{-7} [a]
Polyurethane (solid)	0.25[c]	—
Polystyrene (solid)	0.15[a]	1.0×10^{-7} [a]
Air	0.025[a]	—
Carbon dioxide	0.016[a]	—
Trichlorofluoromethane (CCl_3F)	0.008[a]	—
Oak ($\rho^*/\rho_s = 0.40$)	0.150[a]	—
White pine ($\rho^*/\rho_s = 0.34$)	0.112[a]	—
Balsa ($\rho^*/\rho_s = 0.09$)	0.055[a]	—
Cork ($\rho^*/\rho_s = 0.14$)	0.045[a]	—
Polystyrene foam ($\rho^*/\rho_s = 0.025$)	0.040[b]	1.1×10^{-6} [b]
Polyurethane foam ($\rho^*/\rho_s = 0.02$)	0.025[b]	9.0×10^{-7} [b]
Glass wool ($\rho^*/\rho_s = 0.01$)	0.042[a]	—

All values for room temperature.

References

[a] *Handbook of Chemistry and Physics*, 66th edn (1985–6) Chemical Rubber Co.

[b] Patten, G. A. and Skochdopole, R. E. (1962) *Mod. Plast.*, **39**, 149.

[c] Schuetz, M. A. and Glicksman, L. R. (1983) *Proc. SPI 6th International Technical/Marketing Conference*, pp. 332–40.

The physics behind this deserve to be briefly elaborated upon in order also to better understand the features desired while manufacturing foams.

The thermal conductivity of an expanded polymer can be considered as sum of four contributions:
1. **λs**, the thermal conductivity through the solid walls of the material;
2. **λs**, the thermal conductivity through the cells of the material (and therefore through the gas phase);
3. **λc**, the contribution to thermal conductivity due to convective motions inside the cells,
4. **λi**, the contribution to thermal conductivity due to irradiation within the individual cells and through the walls of the cells.

Hence, the total conductivity is:

$$\lambda_{tot} = \lambda_s + \lambda_g + \lambda_c + \lambda_i$$

The contribution **λc**, due to convective motions, only matters when the Grashof's index (describing the ratio of buoyancy to that favors convection and the viscous forces opposing it) is greater than approx. 1000 (Holman, 1981) and, considering the typical parameters associated with the phenomenon it can be easily displayed that this happens with a size of the cell above 10 millimeters. The polymeric foams, in general, have cells whose average size is at least one order of magnitude smaller than the value just calculated; it is therefore evident that the contribution made by this term is negligible, so the analysis can be focused on three contributions only:

λ tot= λs+ λg+ λr

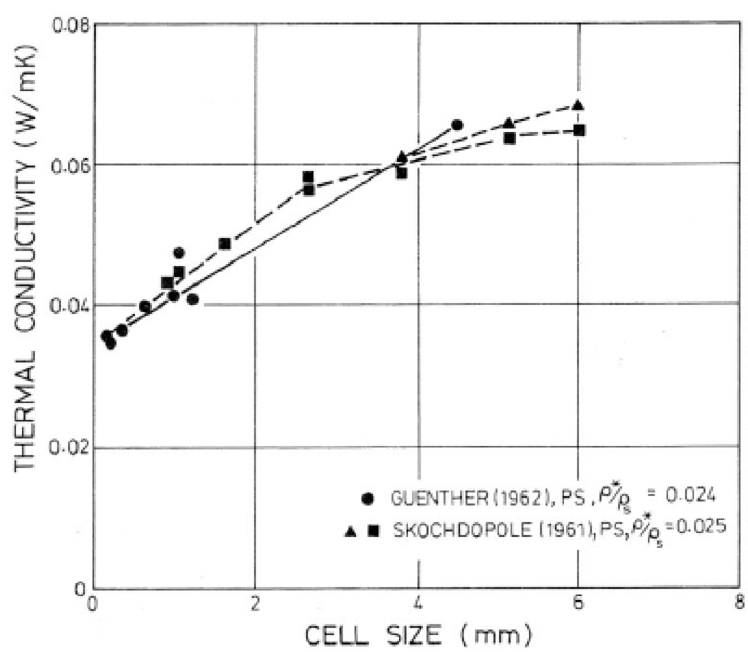
The contribution **λs** can be calculated as the product of the conductivity of the solid, by its volumetric fraction (solid volume / total volume), multiplied by a factor of efficiency describing the tortuosity of cell walls (Schuetz and Glicksman, 1983). A typical value for such efficiency factor ranges around 60-70%.

Typical value result in **λs** = 0.003 W / m K.

Accordingly, the contribution **λg** can be calculated as the product of conductivity of air, times the volumetric fraction of the gas phase in the foam (1- solid volume / total volume). This typically results in approximately **λg** = 0.024 W / m K.

The outcome of the analysis drives to highlight two important points:

- the solid shaped foam has a conductivity almost 10 times smaller than the gas entrapped in it
- the sum of these two elements strongly depends on the shape of the foam, number of cells and their size
- the smaller the cells are, the smaller the conductivity will be. The limit must be defined depending on the stability of the cells themselves, since if the cell collapse or the walls break all the advantage is jeopardized

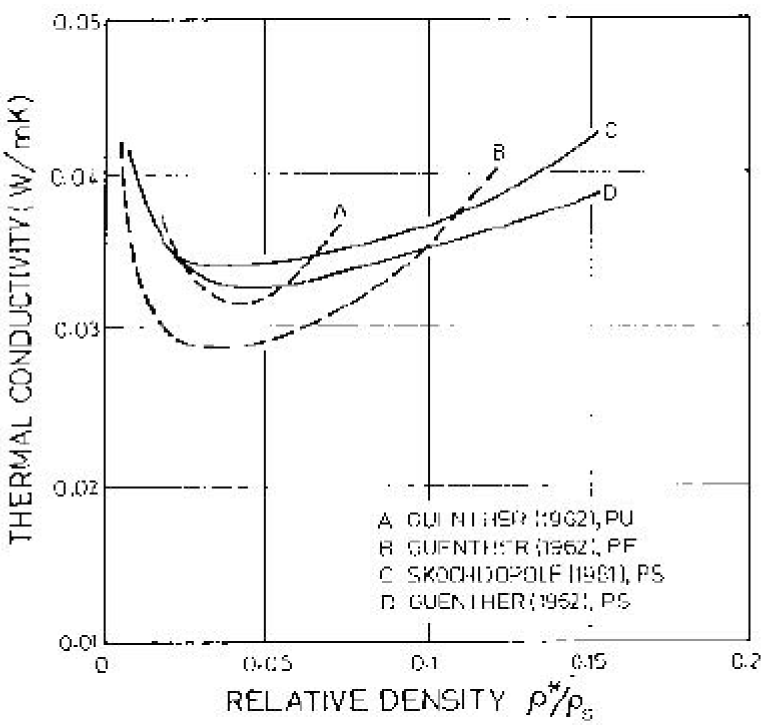


This provides a clear indication of how paramount it is to try to control the geometry of the foams. Furthermore, it illustrates that the number of cells and presence of gas helps to reduce the conductivity; thus, the conductivity is proportional to the density of the foam.

The analysis of the third factor leads to another especially important take away.

The contribution from radiation, **λr**, as duly elaborated by the physical model, decreases with density, like the foam in the cells could obstruct the heat transfer by radiation.

Thus, considering the opposite variation of the two contributions versus density of the foam, it follows that there is an optimum density that provides the lowest conductivity for the foams.



By the above displayed analysis, it appears that polymers foam provide best insulation, when manufacturers are able to control geometry , targetting a specific density (best values within 0,03-0,04), stable cells which walls won't collapse, and cell size in the range of hundreds of microns.

All these desired features can be achieved by means of a very accurate selection of the production process for the polymers foam.

Production process of polymer foams in general

At this point, it is wortwhile to provide a brief description of the the production of thermoplastic polymers foams, which is based on expansion by extrusion that can be simplified as follows:

1. melting of the polymer and mixing with additives (if any)
2. injection of the gaseous expanding agent
3. mixing of the blowing agent into the polymer and formation of an homogeneous mixture polymer-blowing agent
4. pressurization of the solution;
5. thermostating of the solution at the optimal expansion temperature;
6. expansion with the exit of the material from the extrusion head.

The above described process is well consolidated and, in the past, high quality polyethilene foam was manufactured using CFCs and HCFCs as expanding agent.

A solid set of process parameters had been identified to be used with Polyethylene and those gases.

There was no specific need of process additives to control the quality of the foams and the only additives required were specifically designed to meet product specs.

After CFCs and HCFCs gases have duly been banned for their harmful effects on the Ozone, the Industry had to reset on accessible alternatives.

The main options have genrally fallen upon hydrocarbons- mainly isobutane or other similars.

Some attenpts have used Carbon Dioxide (CO_2) and Nitrogen (N_2) . The hydrocarbons as of today have displayed best results, even though, when used stand-alone as an expanding agent , the quality of the foams still has not consistently meet expectations.

As mentioned in the introduction, though, there has been an important appetite to find solutions which could grant adequate results with these gases, since there would be an immediate enviromental and economic benefit.

As a matter of fact, a part of the cost of the feedstock, the use of Isobutane, introduces a high level of complexity in the Polymer foams production plants since it requires the need to put in place all the infrastructure and equipment associated with the handling of such an hazardous gas.

Introducing nano particles into polymer foams

A trailblazing solution in this realm has been the use of nanoparticles.

This idea has proven to grant quality results while using other gases rather than Isobutanes.
It was decided on Polyethylene as Polymer and a mixture of Nitrogen and Carbon Dioxide (80%-20%) in order to seek the most eco-friendly and safe solution.

A solid test campaign has been executed by the Author in order to test the addition of different nano particles in different percentages.

The idea conceived has been to add nano particles in order to control the geometry of the Polyethilene foam.

A brief introduction to the nano particles might be useful.

By definition, the nanofillers used in polymer-matrix nanocomposites can appear as nanoparticles if the dimensions are of the order of nanometers in the three directions.

It has been verified that the addition of this type of fillers allows for significant increases in performance compared to both the base polymer and the conventional particle composite using small percentages of inorganic filler. Available litterature has references for values around 2-6% . The research and testing performed by Author has gathered encouraging results also at sensibly smaller percentages.

The preparation of polymeric nanocomposites is complicated by the enormous surface development of the nanofillers and therefore by their marked ability to aggregate to lower their surface free energy content. The fundamental requirement lies in the fact that the nanoparticles must be individually dispersed in the polymer matrix.

Therefore the preparatory aspect is at the center of the research activity in this sector, as only a few methods are currently available for the preparation of polymeric nanocomposites and often even small differences in the process can completely depress the properties of the composite.

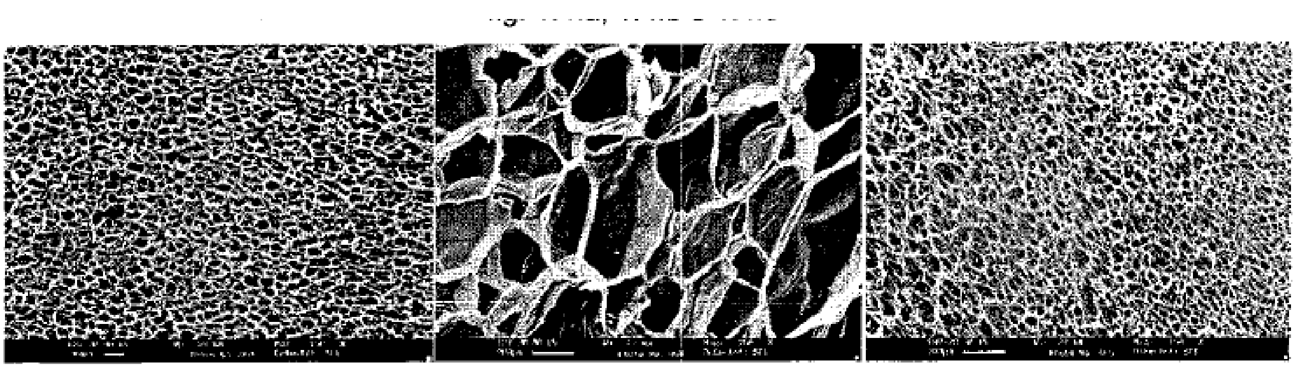
When properly mixed and dispersed, the peculiarity of these innovative materials lies in the intimate mixing (precisely on a "nanometric" scale) of polymers and inorganic particles that produce exceptional and completely out of the ordinary performance.

In particular, the material at the interface between the organic and inorganic phase acquires new properties, intermediate between the two phases, so much so that we can speak of a real "interphase" with a thickness of a few nm. When the dimensions of the dispersed inorganic phase are on a nanometric scale, the interphase material can represent up to 40-50% of the volume of the entire material. The properties of the interphase therefore play a decisive role in the final properties of the material that is being produced. Such composites can have favorable properties, such as barrier strength and high stiffness.

This elaboration should highlight the huge importance of, and the rational to use, additives duly dispersed in the size of nano particles rather than normally mixed.

The research performed by the Author has focused on the testing of three different filosilicate: talcum powder, clay and alumina and crossing the test results with different expanding agent.

The results have been extremely interesting and have shown that small number of nano particles in the range of 0.1-0.2 % are able to grant reduction in equivalent diameter of cells by about 35%, without a sensible impact on density, and displaying a consistent shape of the cells, as shown in the picture below.
The extremely important goal is the possibility to reach on overall conductivity of the foams that could be in the neighborhood of the low 0,040's W / m K.



Future areas of development

The present article has displayed how interesting the results can be while using nano particles.

It's fair to highlight, though, that as of today it is not a mature and readily available solution, and some area of development is required. Subsequently, the following deserve proper attention:

1. availability of nano particles
2. safety associated with handling nano particles.

Nano particles are not easily available on the market and, above all, not in the form of the raw material necessary for this process. As a matter of practice, nano particles are usually only available dispersed in plastic granules and thus they need to be properly extracted before being used in this process.

The second and main aspect is associated with safety of the workforce exposed to nano particles.
Some generic information is present in the Material Safety Data Sheet of the feedstock, nonetheless, the industry still has not developed a solid protocol and methodology statement necessary to provide clear guidelines for handling these materials.

These two aspects deserve the proper attention of the industry to grant safe access to a technology that, as this article has tried to highlight, appears extremely promising and appealing.

References / Citations

FIG #	CAPTURE	SOURCE
1	Cross section of pre-insulated linesets	Patent Application filing number 17/397,285 by Nicola Pilone (inventor) , Owner : PTubes Inc.
2	Thermal conductivity and diffusivity	a.Handbook of Chemestry and Physics, ,66th edition, Chemical Rubber Co b.Patten, G.A and Skochdpole R.E (1962) *Mod. Plast.*, **39,** 149 c.Schuetz, M.A. and Glicksman,L.R. (1983) , *Proc. SPI 6th International Tecnhical Marketing Conference*
3	Thermal conductivity versus cell size for Polymer foams	Guenther (1962) Skochdpole (1961)
4	Thermal conductivity versus relative density for Polymer foams	Guenther (1962) Skochdpole (1961)
5	Polymer foam sample picture from SEM	Courtesy of DPM s.r.l., Italy

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ANTHRACITE CHAPTER MEETINGS & EVENTS 2021-22

Date	Theme		Program	Speaker
Sept. 21	Membership/ Bring-a-Buddy		Bi-Polar Ionization Technology	Carlos Gendron
Oct. 19			Boiler and Generator Venting	Judd Vail
Nov. 16	Research Promotion/ Donor Recognition		Circulator pumps for heat and chilled water applications utilizing ECM and VFD technology	Brett Zerba
December	Family Night		No Meeting	--
Jan. 18	Research Promotion		UVC/UVGI Technology; Effective and Affordable Solutions	Jennifer Flodin
Jan. 29-Feb. 2	Winter Conference/AHR Expo		2020 ASHRAE Winter Conference & AHR Expo, Las Vegas, NV	--
Feb. 15	Engineer's Week Joint Meeting w/ PSPE		Check Valves	Stewart Mills
Mar. 15	Nominating Night Joint Mtg. w/ SMACNA		Desiccant Dehumidification Technology	Chris Morley
April 19	Students/Membership		The Exceptional Advantages of Using Shell & Coil Vertical Heat Exchangers for Generating Heating Hot Water and Domestic Hot Water from Steam.	Rick Kobylinski
	ASHRAE Webcast		TBD	TBD
May 17	**Past-Presidents**		**TBD**	*Dr. William Bahnfleth
Jun. 21	Fun & Fellowship		Mark A. Hagan, PE Memorial Golf Outing	--
	Fun & Research Promotion		TBD	--
Aug. 18-20	Chapters Regional Conf.		2020 Region III CRC	--

ASHRAE MISSION

- To advance the arts and sciences of heating, ventilating, air conditioning and refrigerating to serve humanity and promote a sustainable world.

ASHRAE VISION

- ASHRAE will be the global leader, the foremost source of technical and educational information, and the primary provider of opportunity for professional growth in the arts and sciences of heating, ventilating, air conditioning and refrigerating.

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