Solving Corrosion Under Insulation Utilizing FOAMGLAS® Cellular Glass Insulation Systems

NACE International
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Pittsburgh Corning Corporation
Pittsburgh Corning Europe

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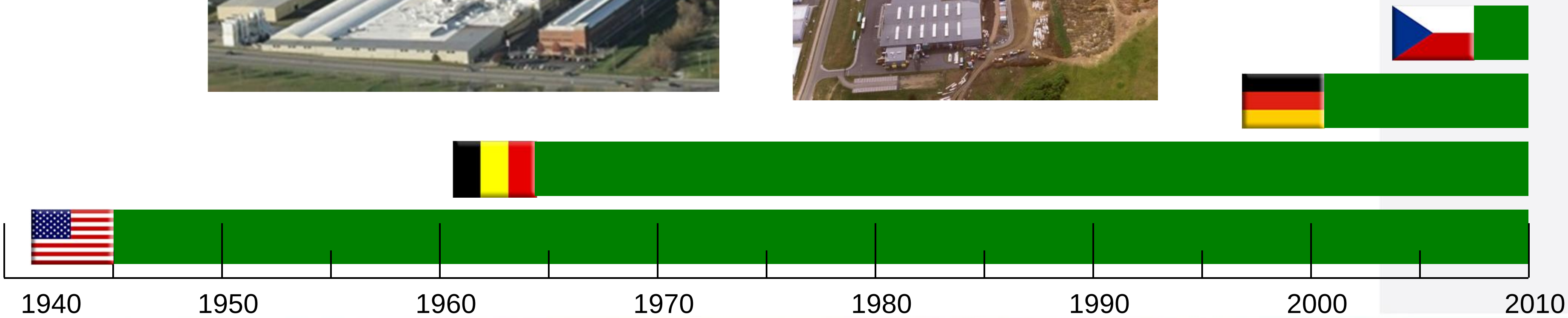
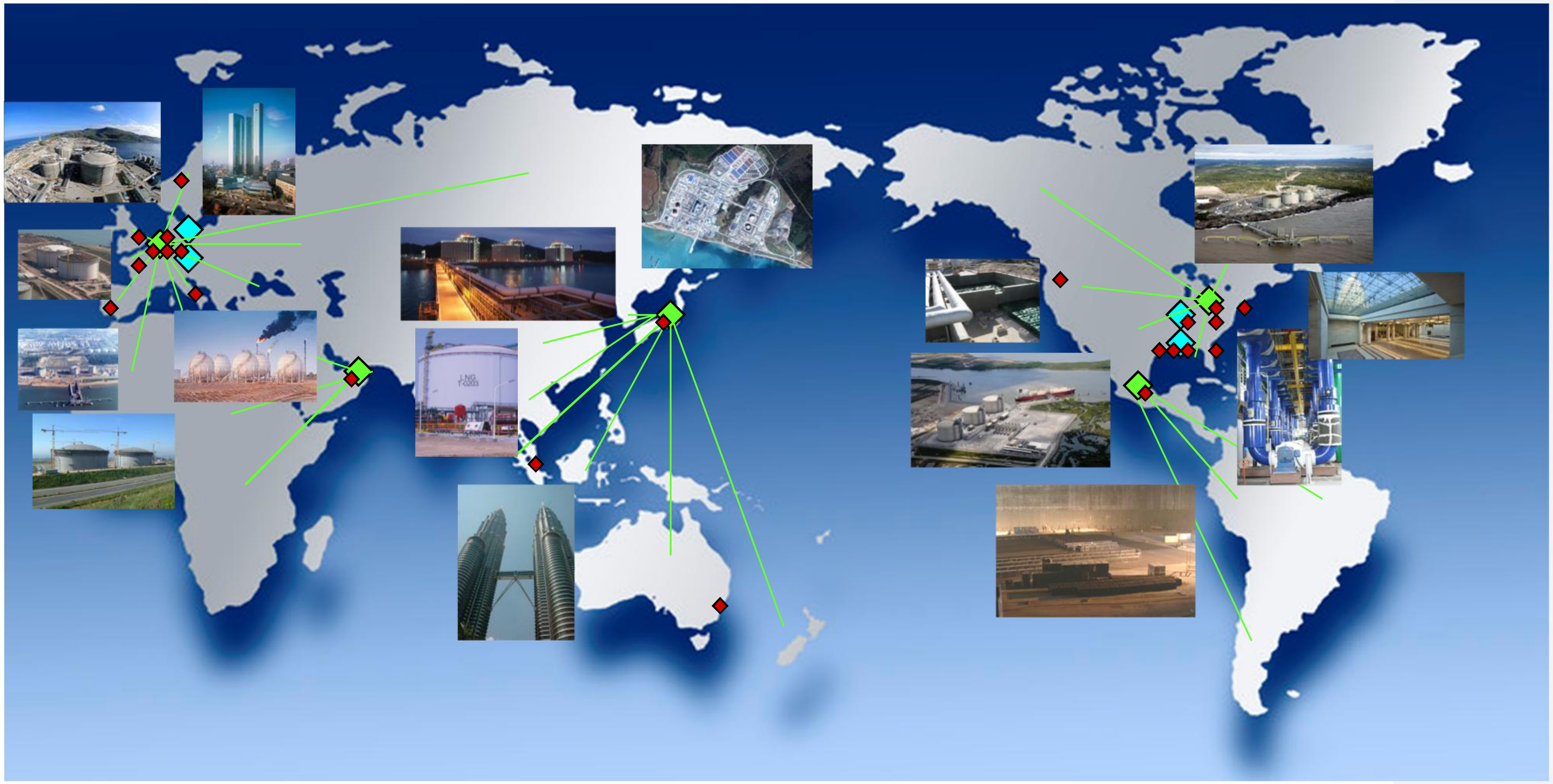
Our Global Reach



Advantages: Exceptional Service…Worldwide and Anytime



- Global network of sales and engineering professionals
- The only cellular glass manufacturer with a truly global reach

Corrosion: Ugly and Hazardous

98% of all insulation system failures are caused by moisture intrusion.

Problems Associated With Wet Insulation

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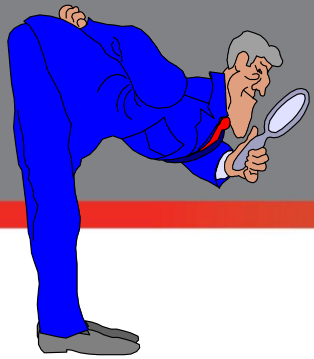
Corrosion Under Insulation

Affects heat gain or loss which leads to increased energy consumption

Increased boil-off from low temperature tanks and risk of solidification of certain materials designed to operate at high temperatures.

Damage can also result within support systems due to increases in the weight of the saturated insulation system.

CORROSION UNDER INSULATION

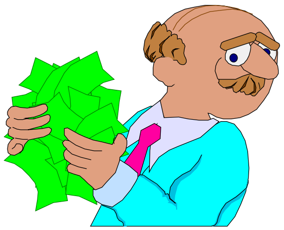


THE PROBLEMS WITH CORROSION UNDER INSULATION

- ***THE RATE OF CORROSION OCCURS AT A MUCH HIGHER SPEED***

- ***THE CORROSION UNDER THE INSULATION CAN'T BE VISUALLY DETECTED UNTIL FAILURE OCCURS***

CONSEQUENCES



- ***COSTS INDUSTRY MILLIONS OF DOLLARS***

Replacement cost of corroded equipment
Loss of productivity/production

- ***SAFETY ISSUES***

CUI can go undetected until leaks occur
Leaks can be hazardous/fatal with combustible liquids or gases at high temperatures or pressures

FACTORS INCREASING THE POTENTIAL FOR CUI

- ***AERATED WATER MUST BE PRESENT***

- ***RATE OF CORROSION DEPENDS ON THE CHEMICAL CONTENT OF WATER***

- ***RATE OF CORROSION DEPENDS ON THE TEMPERATURE***

Aerated Water Must Be Present

The Two Primary Water Sources Involved In CUI Of Carbon Steel Are:

- *Infiltration from external sources*
- *Condensation (internal)*

Examples of External Water Sources

- ***Rainfall***
- ***Drift from Cooling towers***
- ***Condensation falling from cold service equipment***
- ***Steam Discharge***
- ***Process liquid spills***
- ***Spray from fire sprinklers,deluge systems,washdowns, etc.***

THE RATE OF CORROSION DEPENDS UPON THE CHEMICAL CONTENT OF THE WATER

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The Chemical Content of the Water Can Affect the Rate of Corrosion Two Ways:

- *Contaminants can increase the electrical conductivity of the water thereby increasing the corrosion rate.*

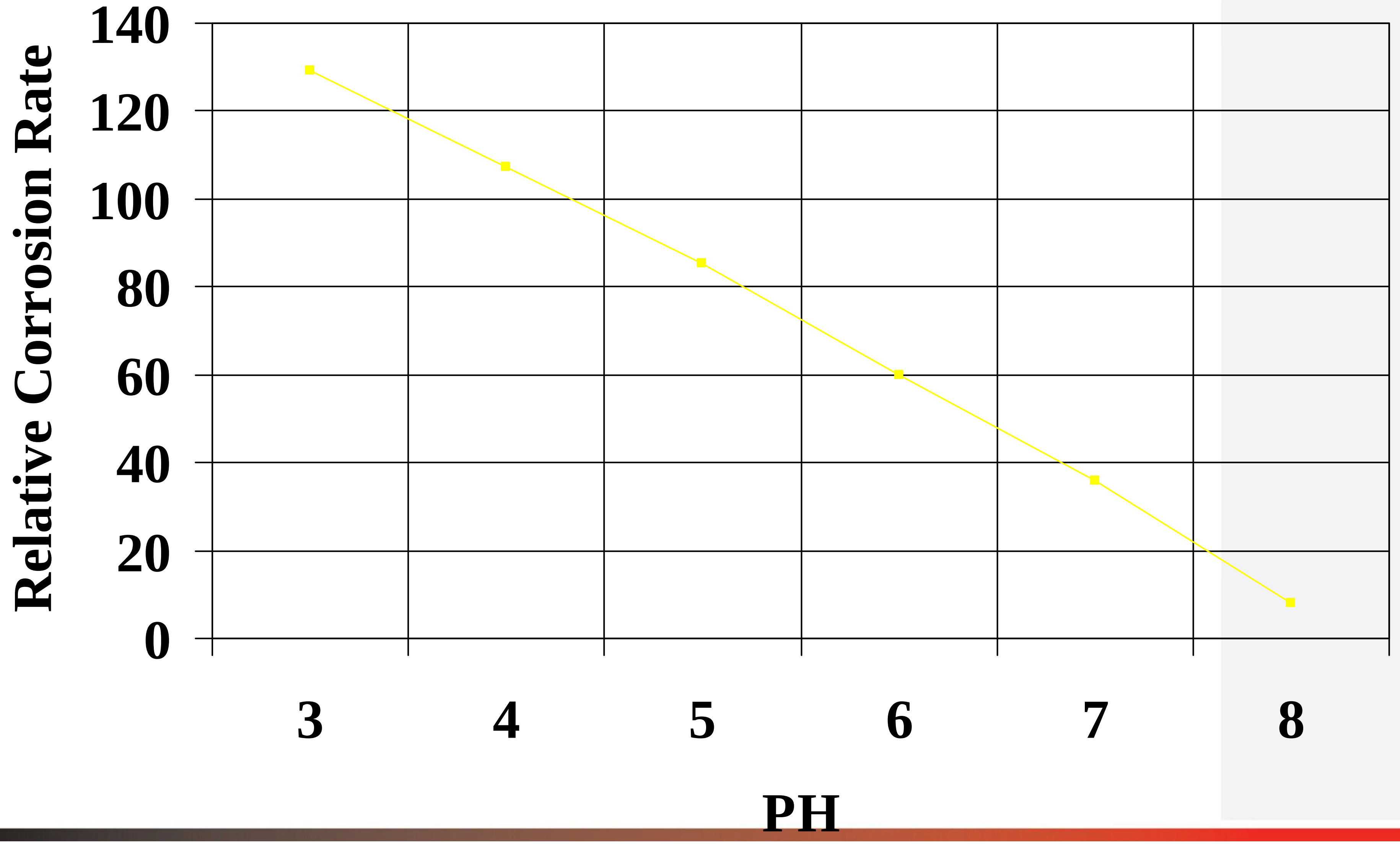
- *Contaminants causing low pH solutions reduce the protection offered by product scale on carbon steel.*

Low pH Contaminants Come From Two Primary Sources:

- *External to the insulation*
- *Contaminants leached from the insulation*

NACE reports **-** Chlorides and Sulfates are the principle contaminants found under insulation. These contaminants are particular detrimental because they are highly soluble in water and these aqueous solutions have a very high electrical conductivity

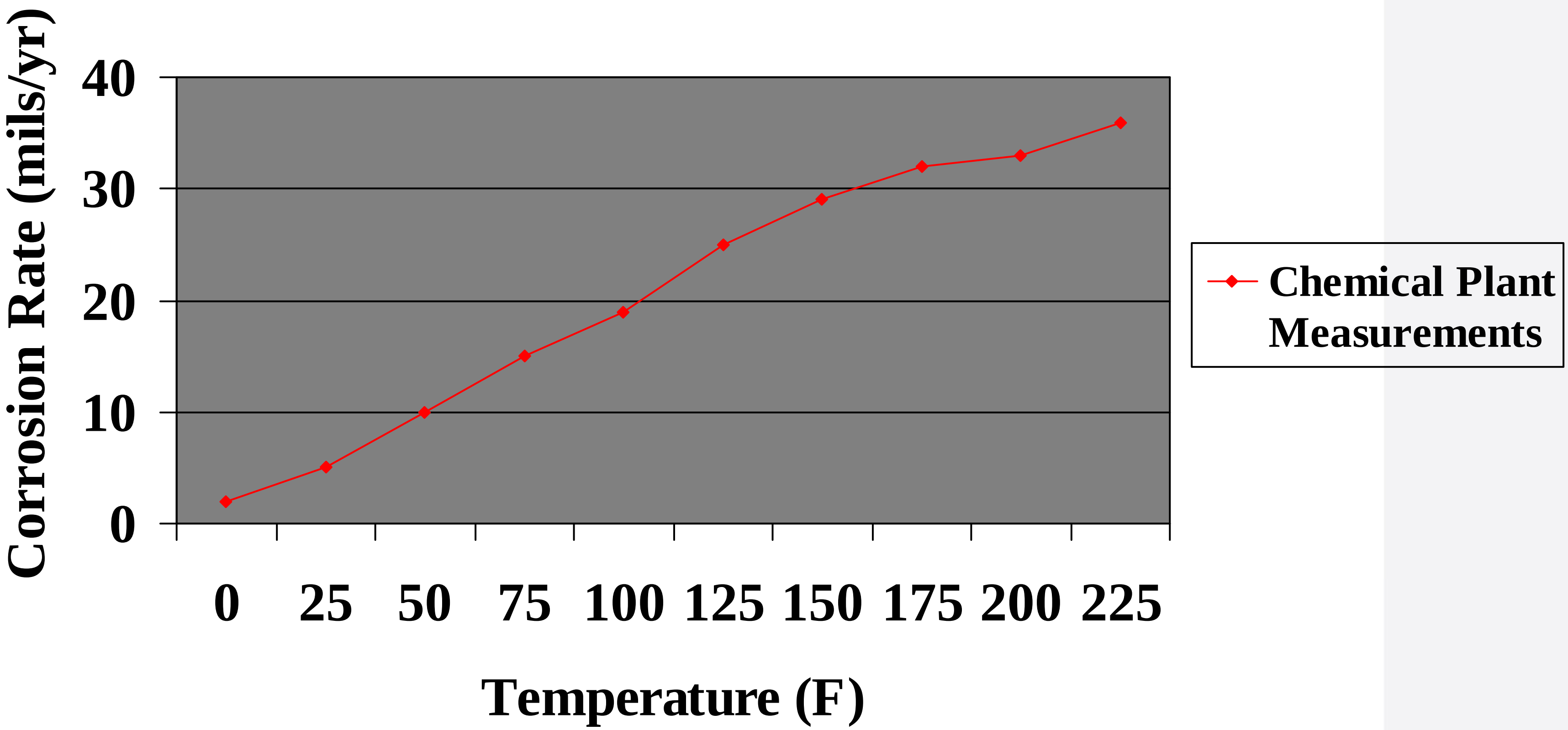
Effects of pH on Corrosion Rate



RATE OF CORROSION DEPENDS ON THE TEMPERATURE

- *Carbon steel operating in the temperature range of ambient temperatures (prox.) to 300 ° F (149 ° C) is at the risk of CUI*
- *Within 32 ° F to 212 ° F (0 ° to 100 ° C) the Rate of corrosion increasing with temperature doubling every 27 ° F to 36 ° F (-2.8 ° C to 2 ° C).*
- *For carbon steel the maximum corrosion rate has been given as ambient to 250 ° F (121 ° C) .*
- *For stainless steel there appears to be little or no problem of stress cracking corrosion below 120 ° F and above 250 ° F (49 ° to 121 ° C).*
- *Cyclic Temperatures will accelerate metal corrosion*
- *Lines below 25 ° F (-4 ° C) can also be subjected to CUI because of extended plant shutdowns.*

RATE OF CORROSION DEPENDS ON THE TEMPERATURE



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Common Approaches for Minimizing Corrosion Under Insulation

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- ***Prevent Water Entry into the Insulation System***

  Use of weather and or vapor retarders

  Problem - they are not long term solutions

- ***Provide a Physical Barrier***

  These barriers are usually paints or mastics

  Problems - thin coatings that require good adhesion and do require periodic maintenance. Usually require controlled temperatures during application.

- ***Select an Insulation that will***

  Minimize water intrusion

  Not wick or retain water

  Have low chloride content

The Solution : FOAMGLAS® Insulation

- *Will help to minimize water intrusion and retention since it is impermeable*

- *Will not accelerate the corrosion of carbon steel or the stress corrosion of stainless steel. pH >7*

- *Can be used as a component of a corrosion resistant barrier*

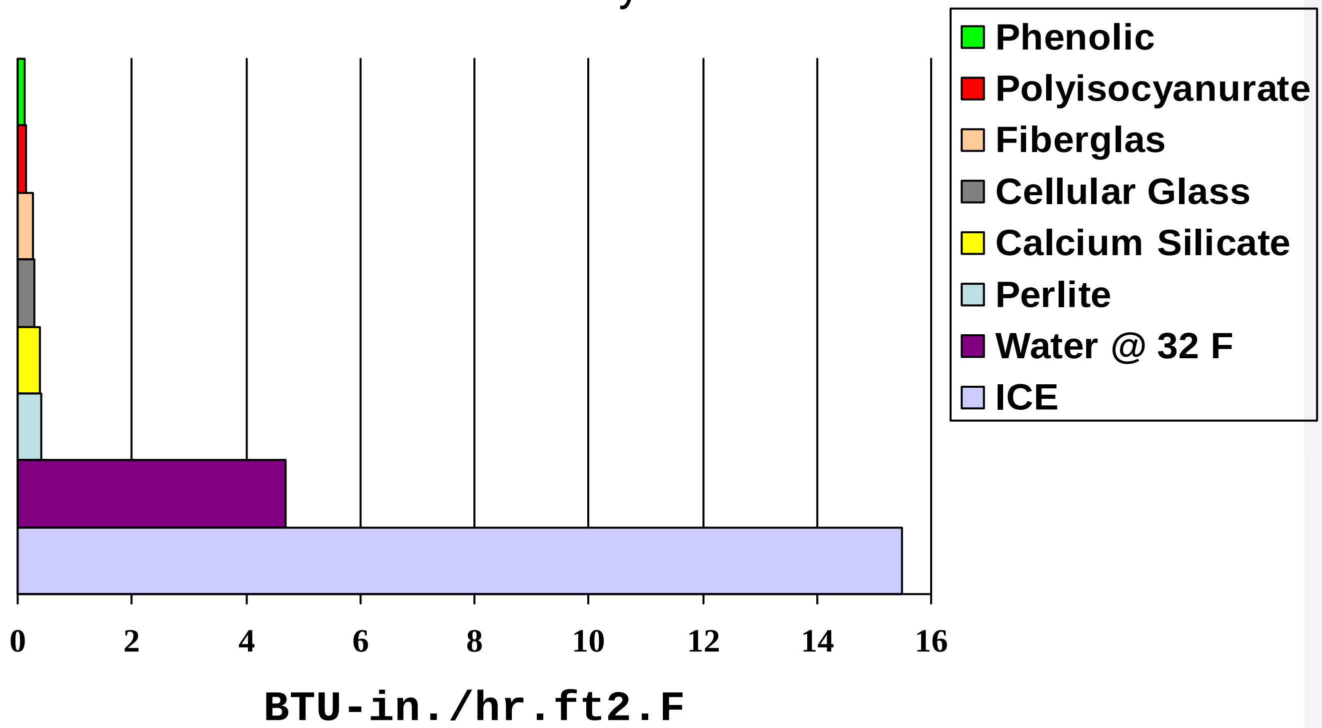
- *Very low chloride content for use in contact with austenitic stainless steel*

Definition of Thermal Conductivity

The amount of heat transferred through a unit area of a material in a unit time, through a unit thickness, with a unit of temperature difference between the surface of the two opposite sides.

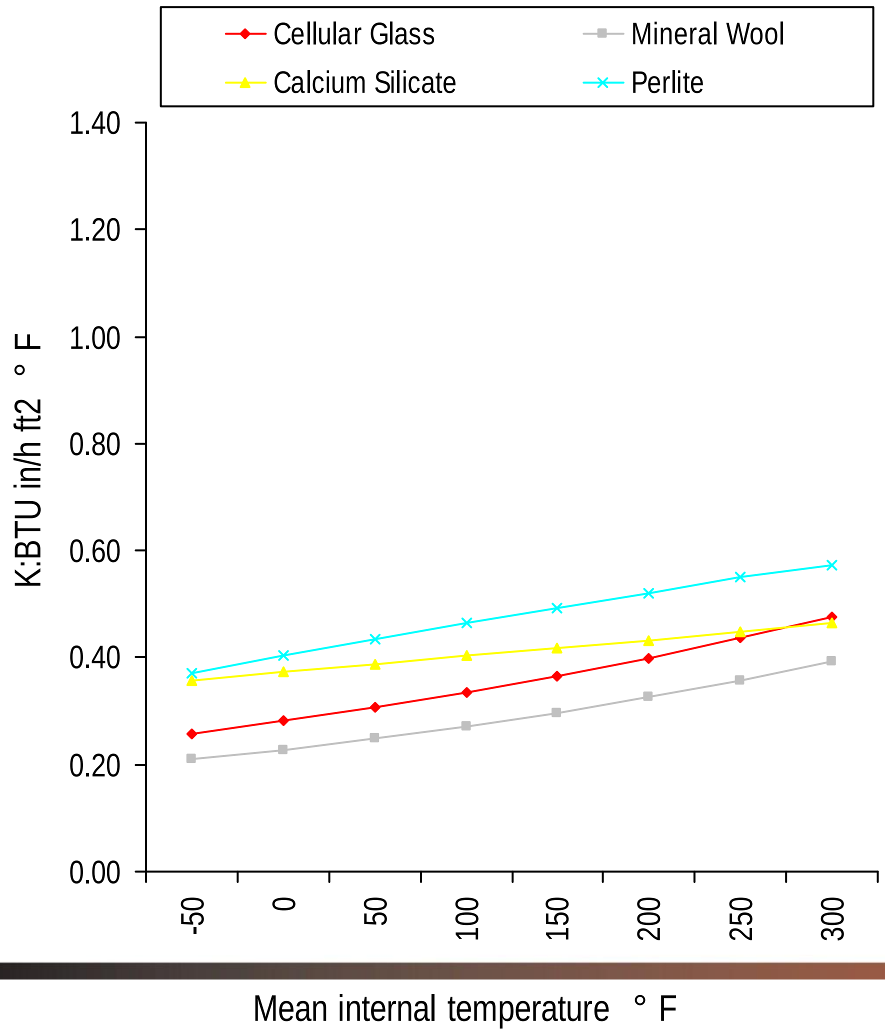
$$\text{Heat flow} = \frac{\text{Temperature difference}}{\text{Thickness/Conductivity}}$$

K= Btu in/h ft2 ° F

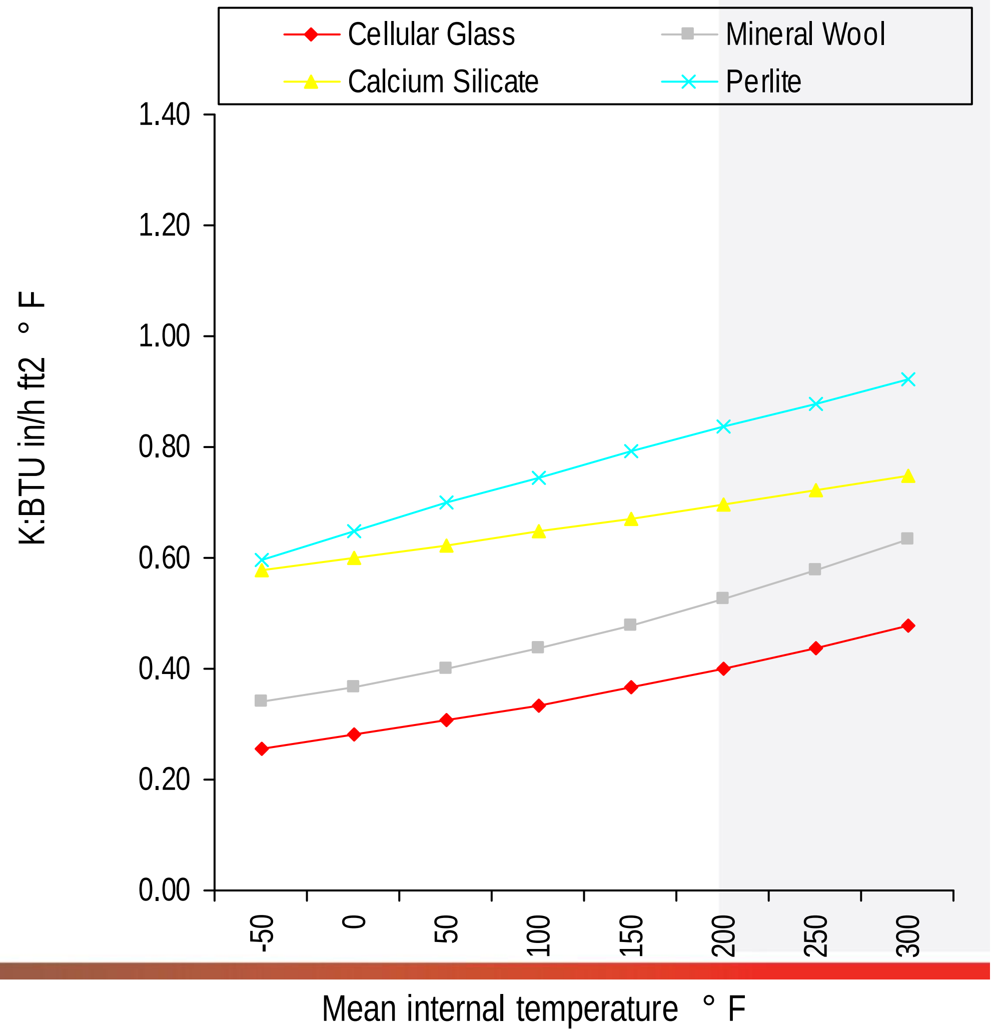


Thermal Conductivity of Insulation vs. Water Content

Thermal Conductivity of Insulation Materials Under Ideal Laboratory Conditions (DRY)



Thermal Conductivity of Insulation Materials with 3% Water Content by Volume



Effects of Absorption Repellents on Water Absorption

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Silicone treatments are designed as water repellents on high temperature insulation materials. However these "binders/repellents" begin to deteriorate at temperatures as low as 175 ° F and are typical completely gone by 450 ° F. Other binders are subject to deterioration at low to moderate service temperatures over extended periods of atmospheric exposure.

SPROULE WR-1200
WATER ABSORPTION HEAT AGING TEST (a)

TYPE OF INSULATION (c)	% AMBIENT WATER ABSORPTION (b)			REMARKS (d)
	400°F	500°F	700°F	
Mineral Wool	128	395	—	Loss of strength above 500°F
Fiber Glass	210	—	—	Loss of strength above 400°F
Calcium Silicate	443	466	466	Reaches saturation at 500°F
Other Perlites (e)	29	41	85	Loss of strength above 500°F
Sproule WR-1200	27	28	64	Original strength maintained

d) Loss of strength was caused by failure of the insulation binder. (Note that cellular glass was not tested since it is presumed to be water resistant at all temperatures.

Absorption & Retention of Water

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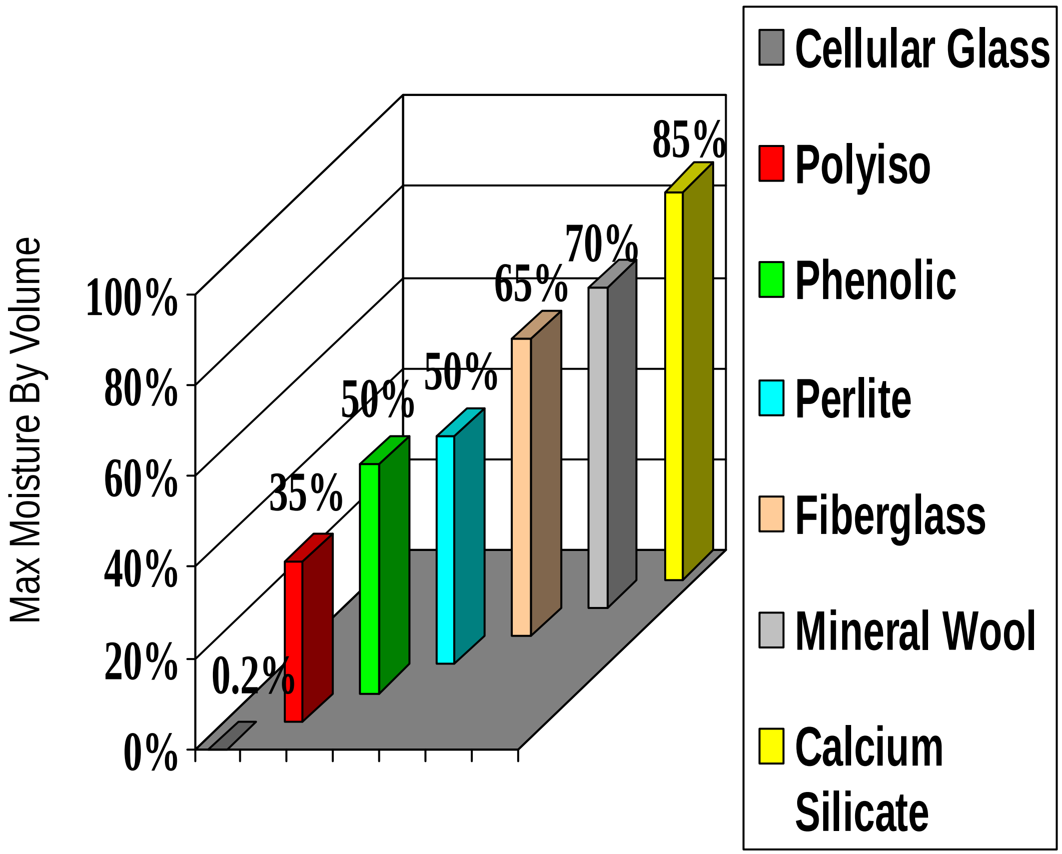


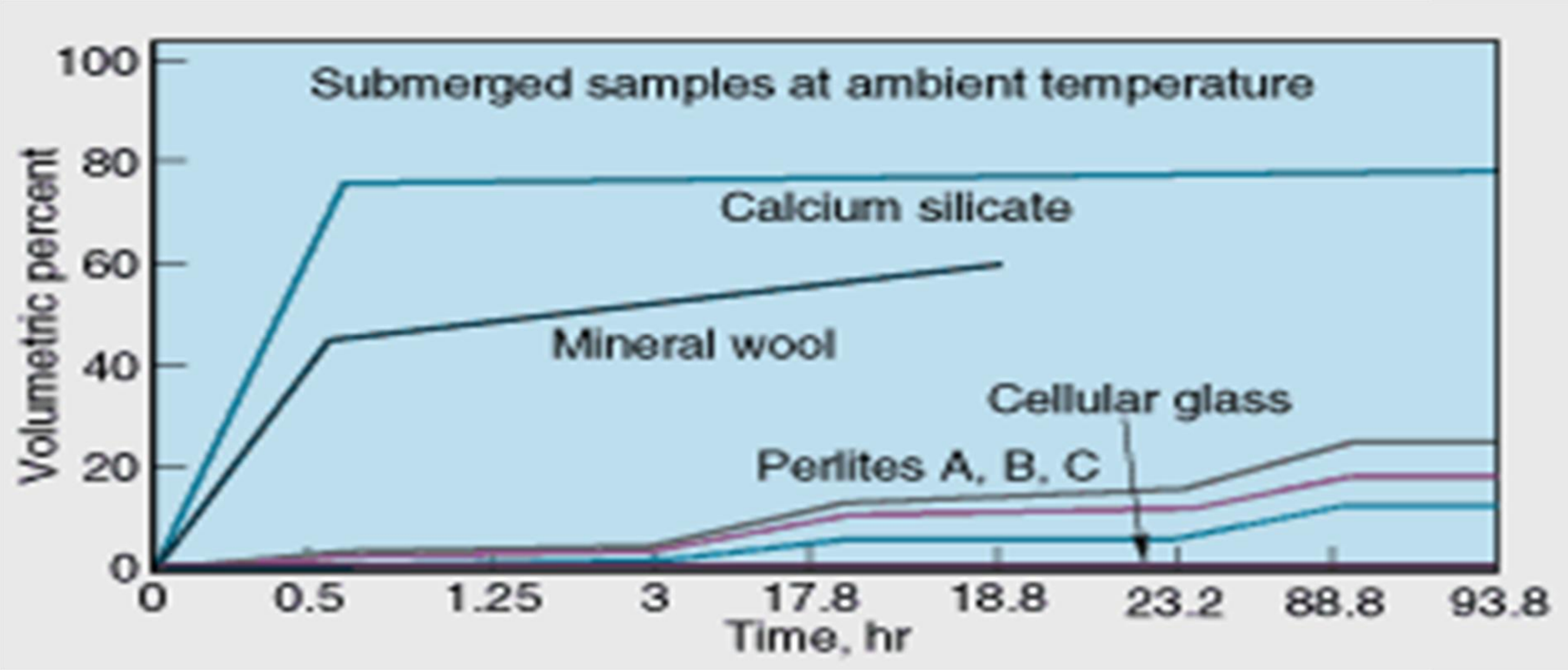
<u>Published Absorption Values %Volume</u>

Cell. Glass - 0.2%
Polyiso - 2%
Phenolic F. - 0.5%
Perlite - 0.4%
Fiberglass - 0.2%
Mineral W. - Not Available
Calsil - Not Available

<u>Data generated by submersion, vapor gradient, and steam exposure.</u>

Data Source- Dr. Chester P. Smolenski, V.M. Liss, PC Lab results

Water Absorption of Above Ambient Insulation



Service Temperature: -450 ° F to 900 ° F (-268 C to 482 C)

Multiple Bonding Techniques for high temperature ranges

- **Hydrocal B-11 Bonded**
- **PC 136 Bonded (low chloride)**
- **Strata Fab Billets**
- **PC 400 Bore coating**

Check with Pittsburgh Corning Technical for the best fab adhesive for your application.

Mastics and Fabrics

Title		**Properties**
PITTCOTE® 300		Asphaltic Vapor Retarder 6 to 8 Gal/100ft2, .003 Perm-in Service Temp -40 to 200F (-40 to 200C)
PITTCOTE® 300FR		Fire Resistant Vapor Retarder 6 to 8 Gal/100ft2, .003 Perm-in Service Temp. -60 to 325F (-50 to 160C)
PITTCOTE® 404		Acrylic -Latex Weather Barrier 6 to 8 Gal/100ft2, .4 Perm-in Service Temp. -30 to 180F (-34 to 80C)
PC® Fabric 79		100% Polyester- 6x5.5 Mesh/inch

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Vapor Retarder Jacketing

PITTWRAP®

Reinforced Polymer Modified
Bituminous Heat Sealed 125 mil
Service Temperature 20 to190 F (-6 to 87C)
.002 Perm-inch, 100 SqFt/Roll

PITTWRAP® SS

Reinforced Polymer Modified
Bituminous Self Sealed 70 mil
Service Temperature -25 to 170 F (-31 to 77C)
.002 Perm-inch, 100 SqFt/Roll

PITTWRAP®
CW PLUS
(NEW IW50)

Reinforced Polymer Modified
Bituminous Self Sealed 50 mil
Service Temperature -25 to 100F (-31 to 37C)
.002 Perm-inch, 147 SqFt/Roll

PITTWRAP®
CW30

Reinforced Polymer Modified
Bituminous Self Sealed 30 mil
Service Temperature -25 to 100F (-31 to 37C)
.002 Perm-inch, 295 SqFt/Roll

Joint Sealants

Title	**Properties**
PITTSEAL® 444N	Butyl Rubber 84% Solids, .008 Perm-inch Service Temp. -70 to 180 F (-56 to 80C) NRC 1.36 chemical requirements
PITTSEAL® CW Sealant	MS Polymer Based >90% Solids, .0015 Perm-inch Service Temp. -40 to 200F (-40 to 93C) Flame Spread/Smoke Dev. <10

Installation Adhesives

Title	**Properties**
PC® 88 	Two Part Adhesive Service Temp. -70 to 180 F (-57 to 80C) Working Time 1 to 1 1/2 Hrs .005 Perm Rating
PC® RTV 450 	High Temp. Silicone Adhesive Service Temp. -50 to 400 F Cont. (-46 to 200C) Max. Intermittent Temp. 450 F Full Cure 24 Hrs

Fabrication Adhesives

Title	Properties	Competitive Products
HYDROCAL® B-11 	Cementitious Fabrication Adhesive Service Temp. -450 to 900 F (-268 to 480C) Working Time 20 to 30 Min. Chemical but not coupon test requirements of NRC 1.36	N/A
PC® 136 	Cementitious Fabrication Adhesive Service Temp. -100 to 900 F (-73 to 480C) Working Time 20 to 30 Min Chemical and coupon requirements of NRC 1.36	N/A

Anti Abrasive Coatings

Title	Properties	Competitive Products
HYDROCAL® B-11  	Cementitious Coating Service Temp. -450 to 900 F (-268 to 480C) Working Time 20 to 30 Min. Meets chemical but not coupon test requirements of NRC 1.36	N/A
PC® 136  	Cementitious Coating Service Temp. -100 to 900 F (-73 to 480C) Working Time 20 to 30 Min Coupon and chemical requirements NRC 1.36	N/A

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Temperature Range 75F to 180 F (24 ° C to 82 ° C)

Insulation may be fabricated with Hydrocal® B-11 or ASTM D312, Type III hot asphalt Fabrication Adhesive. Stratafab® system may be considered. V-Groove method may be used for above ambient applications.

Application Requirements: Insulation may be applied in a single layer. Pipe and vessel insulation may be banded or taped in place using fiberglass reinforced tape. The wires should not be used as banding material. Mastics should only be considered for surfaces not covered with metal.

Temperature Range 181 F to 400 F (83 ° C to 204 ° C)

Applications **Steam, Heat Transfer, Hot Process**

Fabrication Requirements: Insulation must be fabricated using Hydrocal® B-11 fabrication adhesive for non Stratafab® systems. The use of hot asphalt bonded insulation is not recommended. The V-Groove, HTAA bore coated, or Stratafab® system should be considered

Application Requirements: Insulation may be installed in a single layer. Small diameter pipe insulation may be secured by either banding or tape. Tie wires not be used to secure insulation. Joint sealant is not required. Mastics should only be considered for surfaces not covered with metal.

FREE SERVICES

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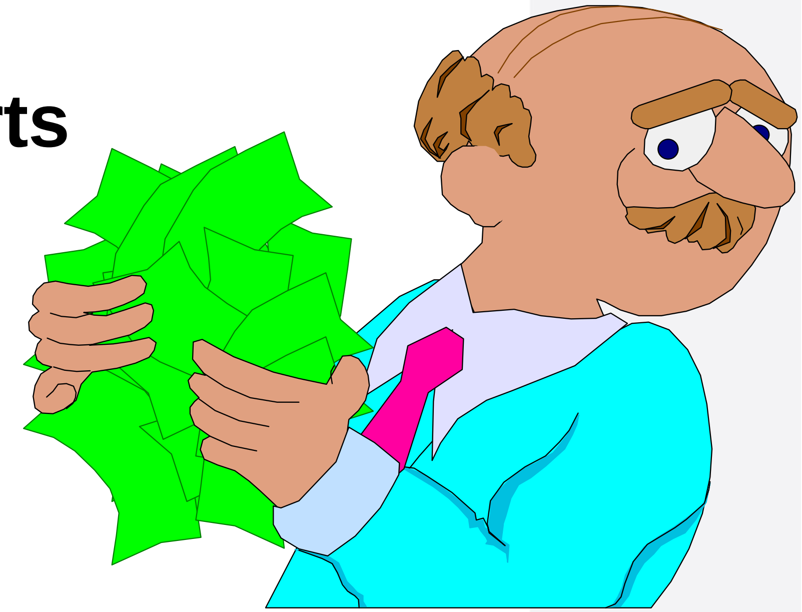
1. Energy Analysis Reports



2. Field Energy Surveys

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4. Written Guidelines and Specification
   Writing Assistance

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