

Advanced Society For Science & Technology

National Conference

‘Innovation and Entrepreneurship in Health’

06-07 April, 2012



India International Centre, New Delhi

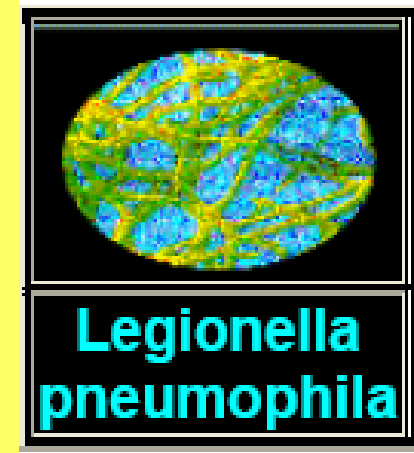
“Legionella and Legionnaires’ Disease (LD): Preventive Measures of its Outbreak & Risk Mitigation steps in Domestic Hot & Cold Water Storage and Distribution Systems” — Homi R. Mullan

Objective of Conference Discussions:

- **Innovation**: Conductive Polymer *Trace Heating* for Domestic Hot Water System.
- **Entrepreneurship**: In Services to Assess, Detect, Monitor & Record, Disinfect, Sterilize *Legionella pneumophila* bacteria.
- **Health**: Preventive measures against outbreak of *Legionnaires' disease* from Domestic Hot Water Systems.

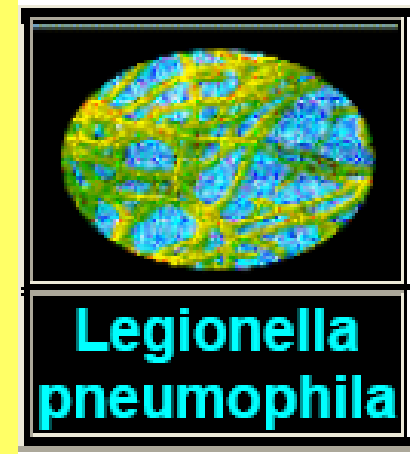
About Legionnaires' disease (LD)-1

- LD is a potentially fatal pneumonia caused by *Legionella* bacteria.
- Infection is caused by Ingestion or Aspiration in small (5 micron) droplets of water caused by fine spray droplets of water contaminated by *Legionella pneumophila* bacteria.
- LD is not a contagious disease.



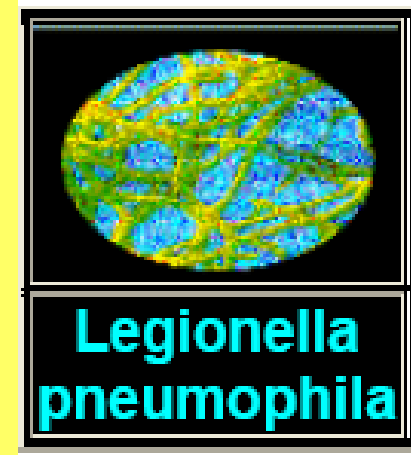
About Legionnaires' disease (LD)-2

- Symptoms- Initially: Flu like illness with tiredness; high fever ($\geq 39.5^{\circ}\text{C}$); Headache; Muscle ache; dry cough. As pneumonia develops: Chest pain; Shortness of breath; Abdominal pain; Vomiting & Diarrhea; and, Hallucinations.
- Risk Groups: above 45-years; Immunocompromised; Children; Smokers; Organ transplant.
- Transmission Mode: by *Ingestion* of fine spray infected aerosols; *Aspiration* of infected potable water.



About Legionnaires' disease (LD)-3

- Risk Areas- Domestic Hot & Cold water systems , Cooling Towers, Humidifiers, Water Fountains in: Hotels, Apartments, Shopping Malls, Swimming Pools, Spas, Hospitals, Dental Clinics, Ships, Jails, Air Conditioners, Nebulization.



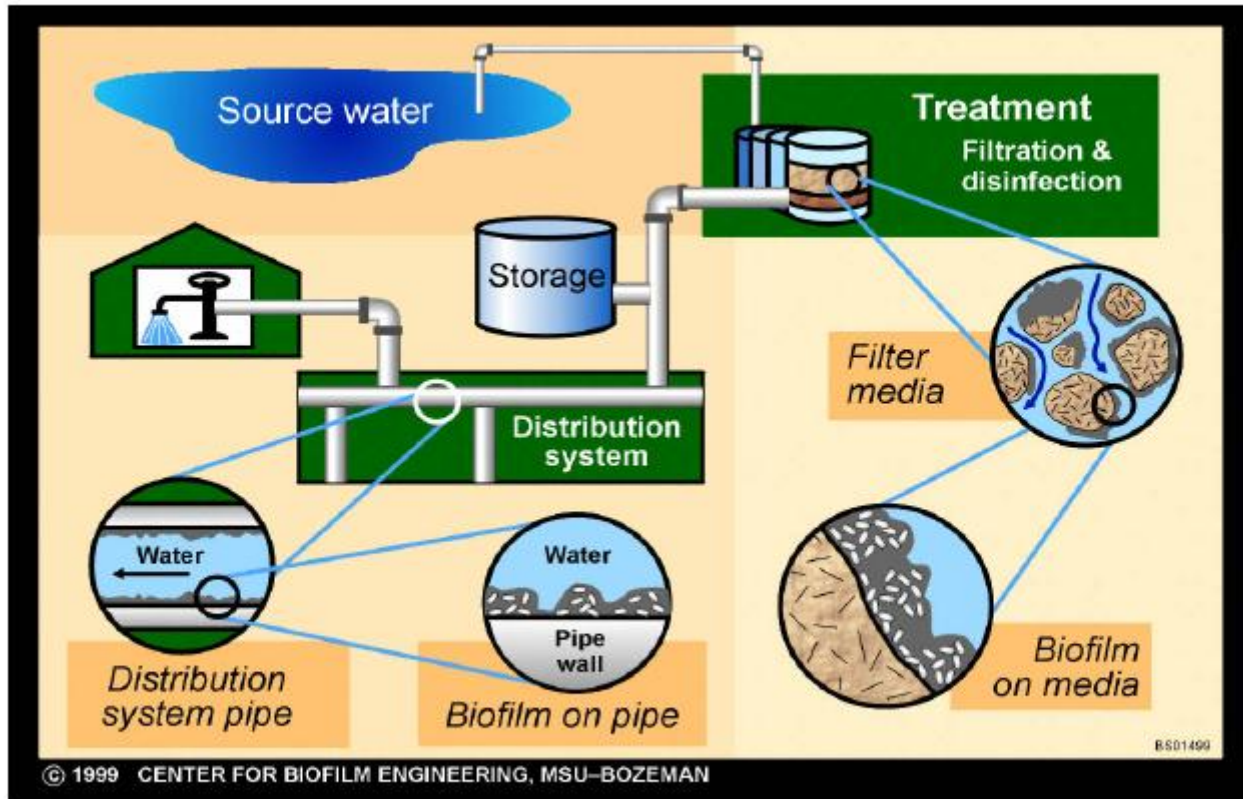
Legionella Amplification Condition

Legionella Amplification conditions:

- Water temperatures between 20°C - 45°C
- Stagnant water in Storage tanks.
- Bio-films, Algae, Rust, Hemp, Rubber jointing, protection to Legionella Bacteria.
- Dead-legs in piping network
- Temp. Stratification in Tanks / Vessels

Legionella B. to Amplify & Multiply Require

Figure 3: Biofilm and Potable Water Distribution Systems



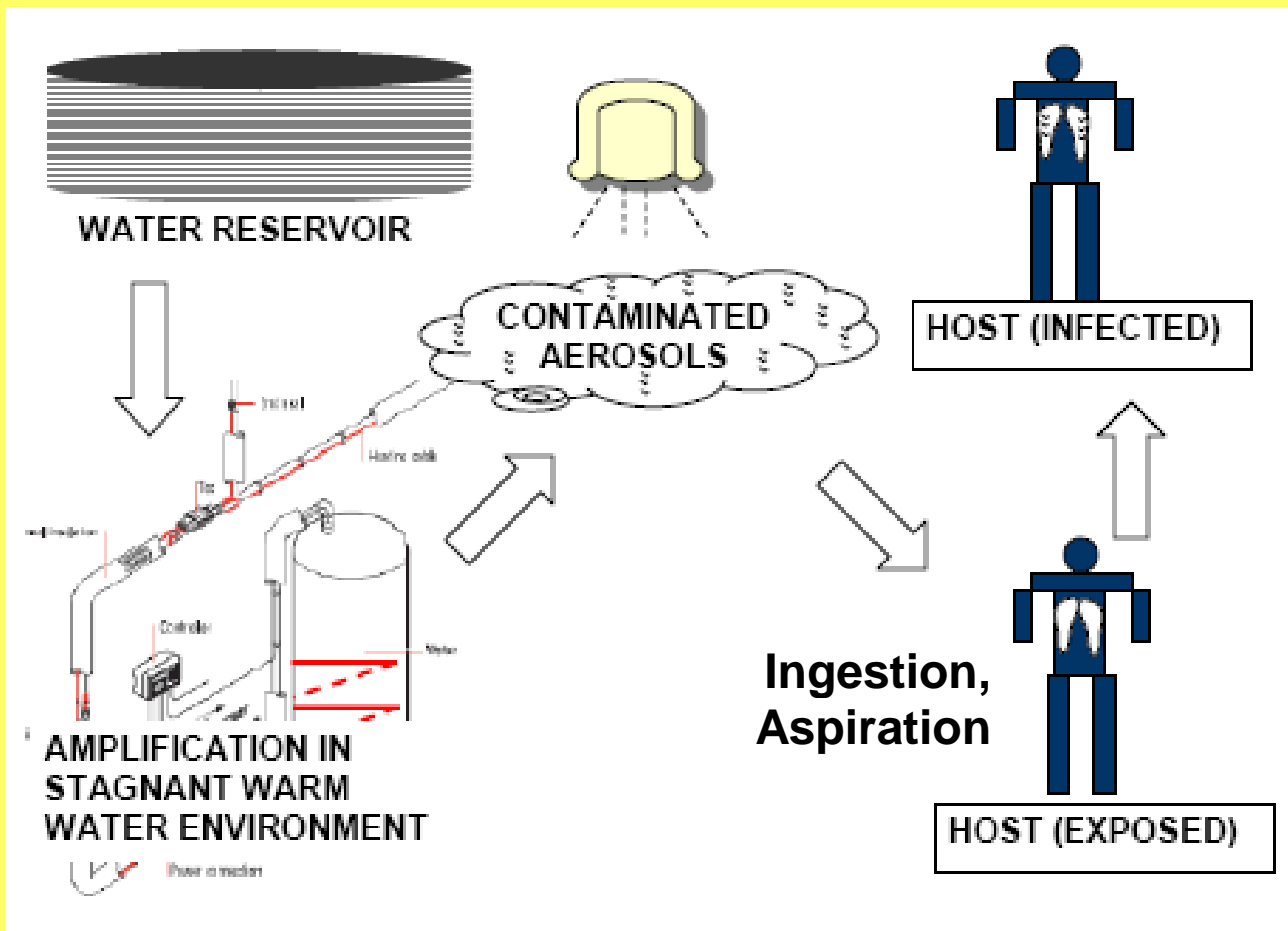
- **Water**

- **Warm temp.**

- **Food**

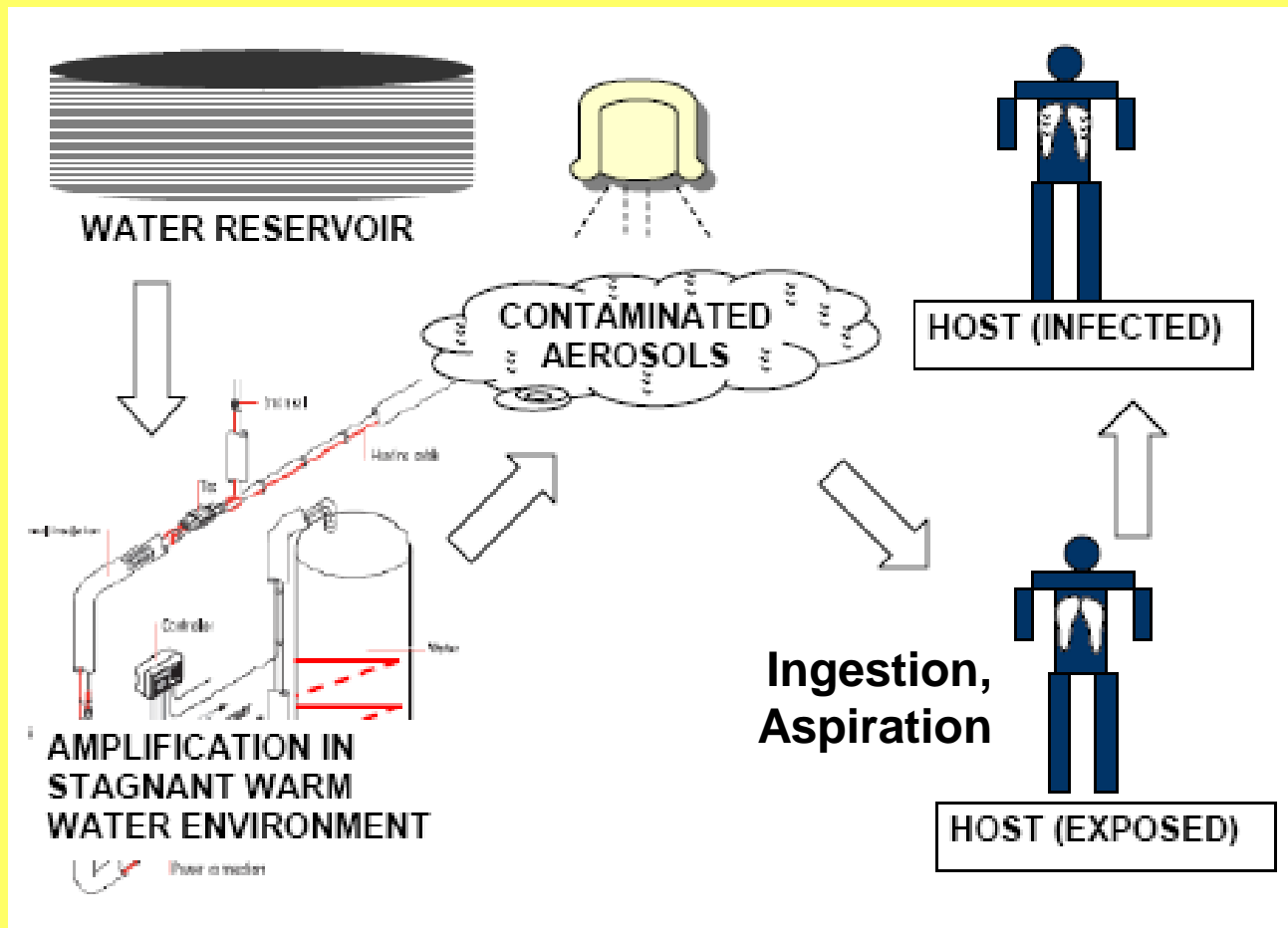
: Figure 3 is courtesy of the Montana State University – Bozeman Center for Biofilm Engineering.

Legionella Cycle



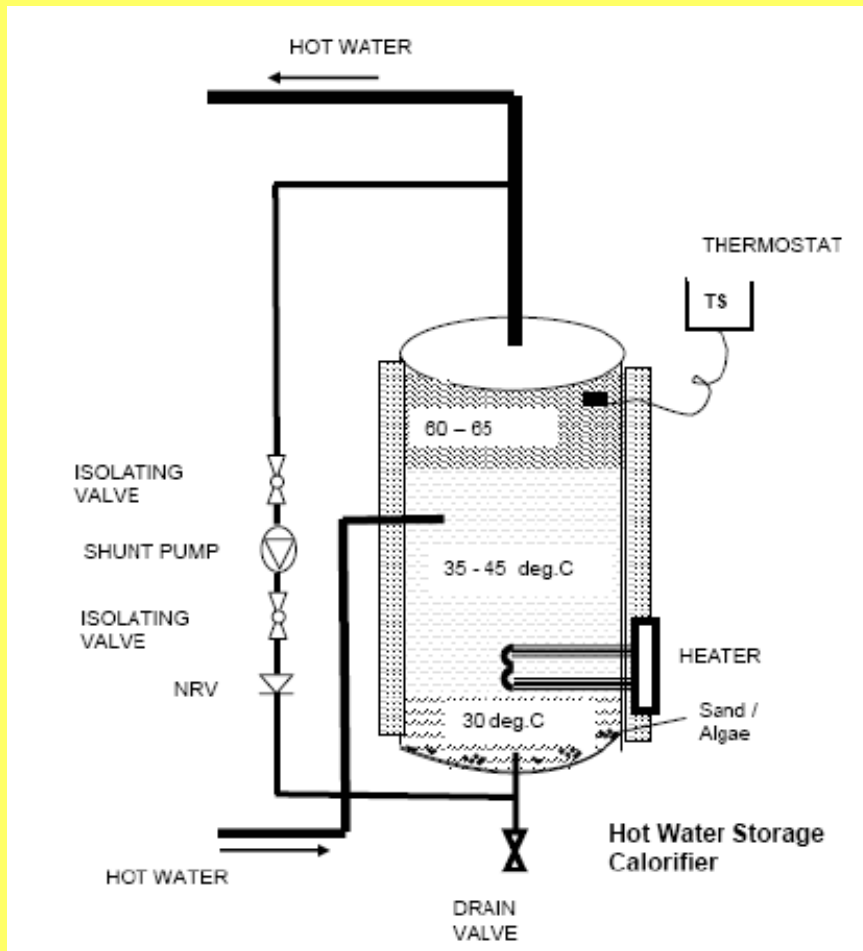
Legionella
Infection
associated
with sources
at a distance
up to 3.2km

Legionella Cycle



Legionella Infection associated with sources at a distance up to 3.2km

Domestic Hot Water Storage & Heating System



- Temp. Stratification
- Thermostat Control
- Shunt Pump
- Sand / Algae at bottom

Legionella Treatment Methods

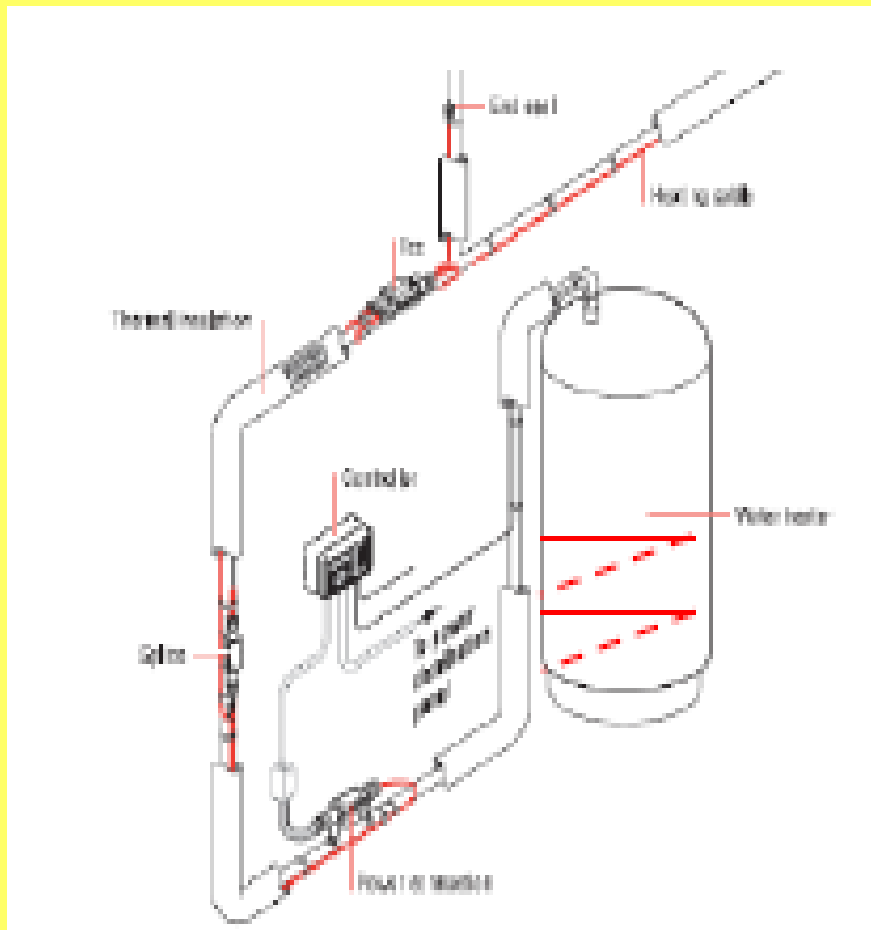
Domestic Hot Water

- Thermal – Temperature maintenance by *trace heating*.
- Biocides- Chlorination
- Copper-Silver Ionization
- Ozonation
- Ultraviolet (UV) radiation
- Chlorine Dioxide
- Heat-and-Flush / heat shock (Temporary Result)

Temp. V/s Legionella Bacteria

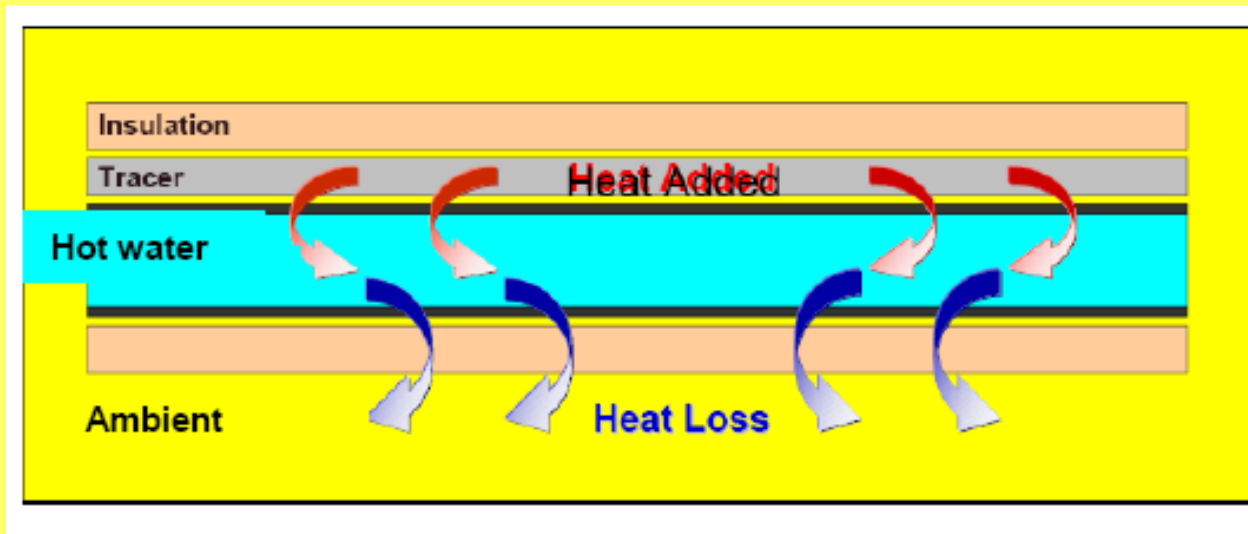
<u>AT WATER TEMPERATURES OF:</u>	<u>LEGIONELLA BACTERIA:</u>
90 deg.C	Pasteurisation / Sterilisation / Kill
70 to 80 deg.C	Disinfection range
66 deg.C	Die within 2-minutes
60 deg.C	Die within 32-minutes
55 deg.C	Die within 5 to 6 hours.
50 deg.C & above	Survive, but do not multiply.
35 to 46 deg.C	Ideal growth range.
20 to 50 deg.C	Growth range.
Below 20 deg.C	Survive, but do not multiply.

Electric Surface Trace Heating of Vessel & Interconnection Piping



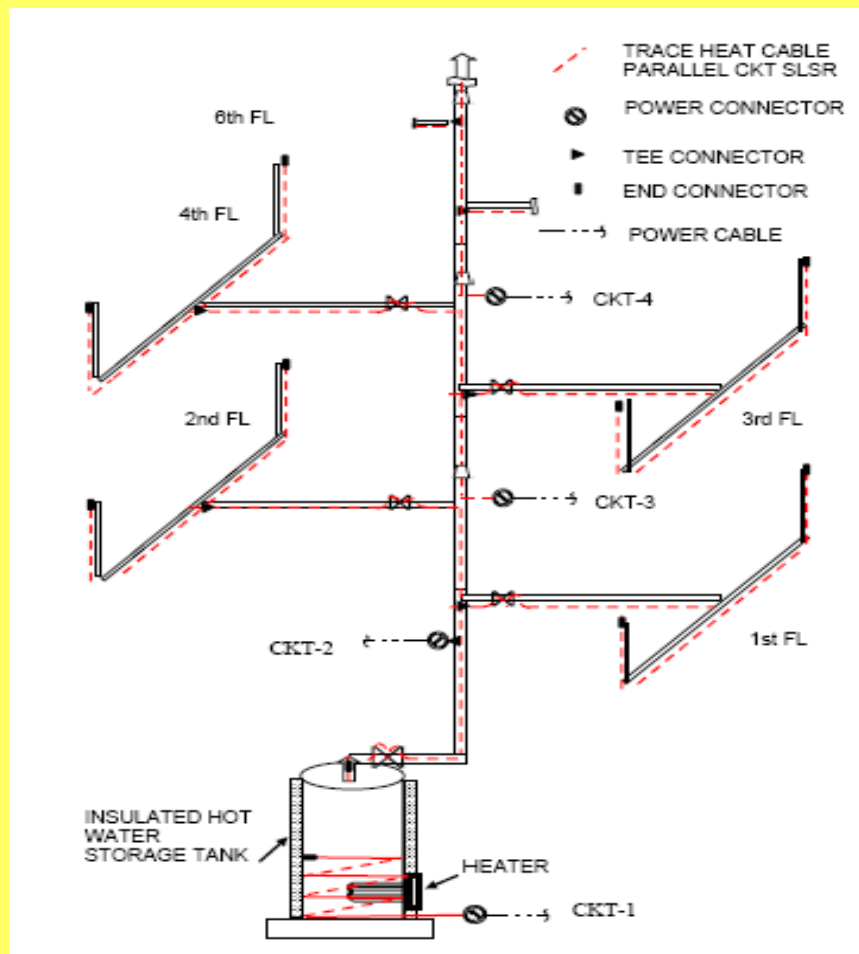
- Design to maintain surface at $\geq 70^{\circ}\text{C}$ to prevent Legionella growth.
- Trace Heat Vessel surface to prevent stratification.

Trace Heating

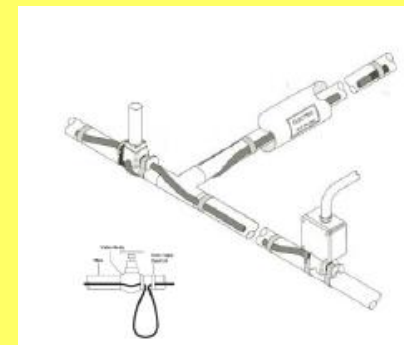


Trace Heat in conjunction with Thermal Insulation, to replenish the heat loss taking place to ambient, in order to maintain design temperatures of water in pipes & vessels, at all times, even during static state.

Domestic Hot water Trace Heating – Non Circulatory System

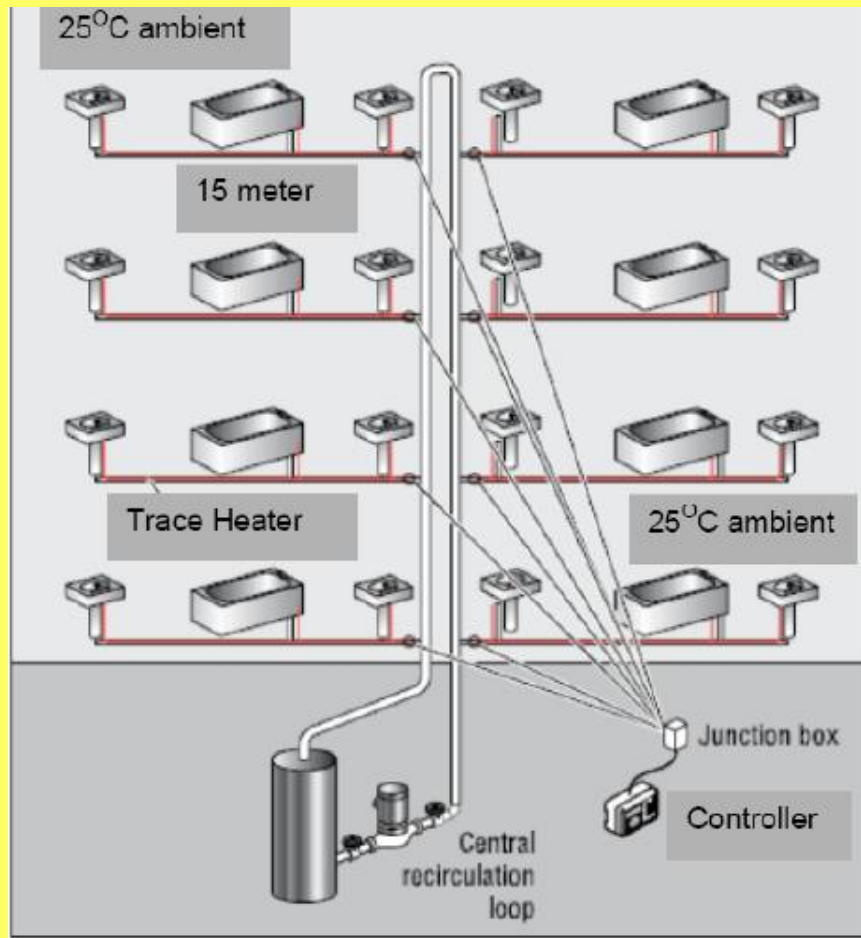


- Eliminates circulation return piping & pump.



- Parallel, Cut-to-length, Self-regulating trace heating.

Domestic Hot water Trace Heating – Circulatory System



- Trace Heat and insulate the branch tapings from circulating mains.
- If continuous circulation is not maintained, trace heat and insulate the mains.

Thermostatic Mixing Valves – To Prevent SCALDING



Thermostatic Mixing Valve

Maximum Outlet Temperature Requirements

Bidet	38 ^o C
Shower	41 ^o C
Washbasin	41 ^o C
Bath	44 ^o C
Supervised bath	46 ^o C

Temperature should never exceed 46^oC

Trace Heat Design Data

Design: Trace Heater Output Rate to Compensate Heat Loss Rate from Insulated Pipes

Ambient temperature	25°C
Maintain temperature	65°C
Differential temperature	40°C
Pipe	metal
Insulation	Fibreglass
Location	Outdoor (wind speed 8.9 meter/sec)
Design Margin	10%

Heat Loss Design Values

[BS: 6351 Part: 2 1983, Appendix A]

<i>Pipe Size: Inches (mm)</i>	<i>Insulation thickness (mm)</i>	<i>Design Heat Loss (W/m)</i>
0.5" (15mm)	20mm	9.5
0.75" (20mm)	20mm	10.9
1" (25mm)	25mm	11.0
1.25" (32mm)	25mm	12.9
1.5" (40mm)	25mm	14.1
2" (50mm)	40mm	12.9
2.5" (65mm)	40mm	13.7
3" (80mm)	50mm	13.4
4" (100mm)	50mm	16.1
6" (150mm)	50mm	21.7

Heat Loss Factors: Valve (Gate / Globe) 1.3; Valve (Ball) 0.8; Rock Wool (.038 W/m.C) 1.06; Mineral Wool (.043 W/m.C) 1.2; Indoor 0.9. The above table values could be used for initial estimate for *trace heating* load plan.

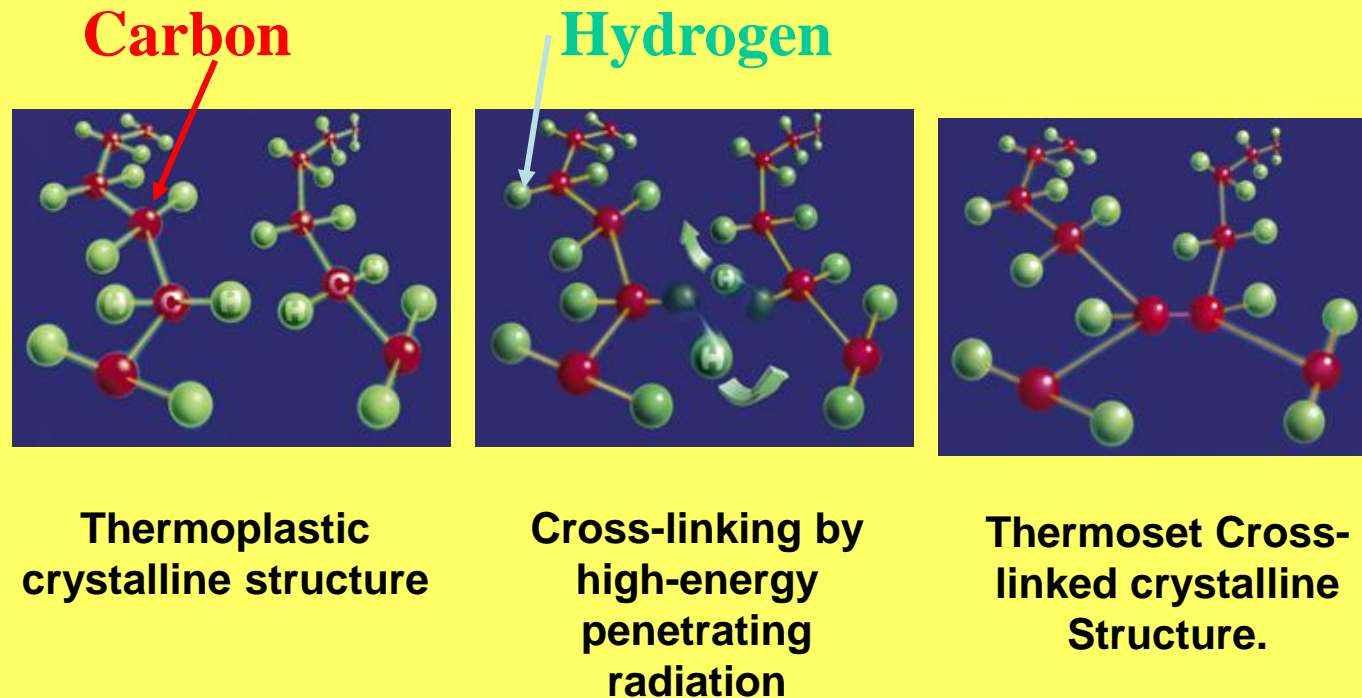
Innovative Technologies

Technology in Self-limiting Self-regulating Trace Heat Cables.

- Radiation Cross-linking of Polymers
- Conductive Polymers.

Polymer Irradiation Technology-1

Radiation Cross Linked Polymer



Polymer Irradiation Technology-2

“Thermoplastic”



Figure 1

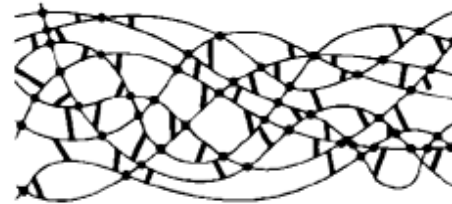
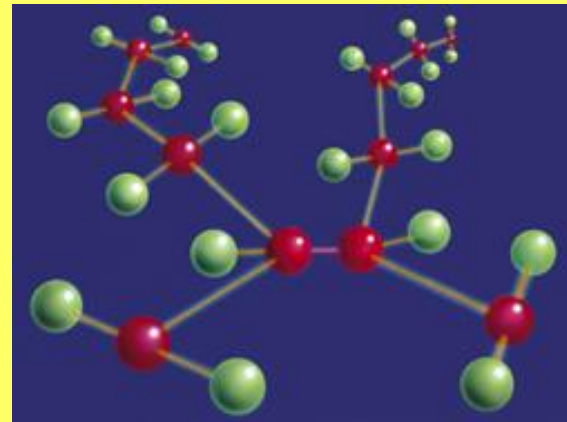
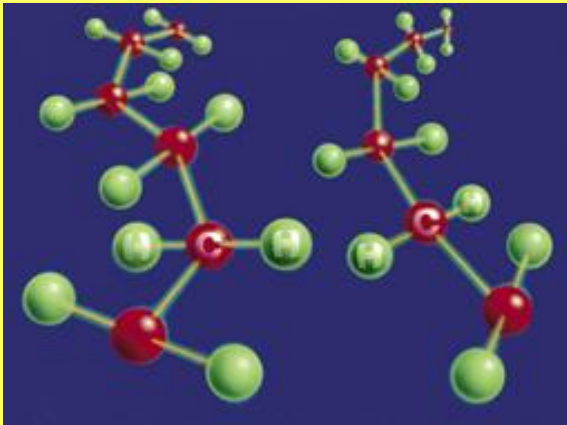


Figure 2

“Cross Linked”
Thermo-set

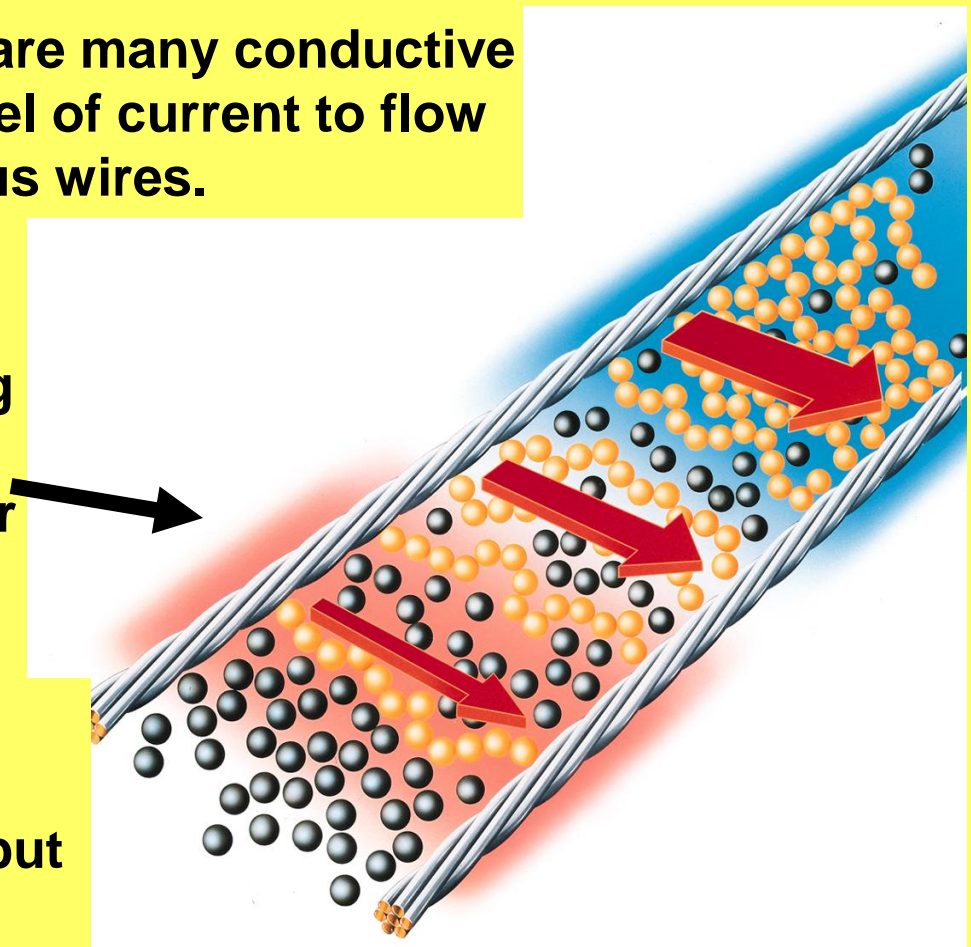


Conductive Polymer Self-Regulating Technology

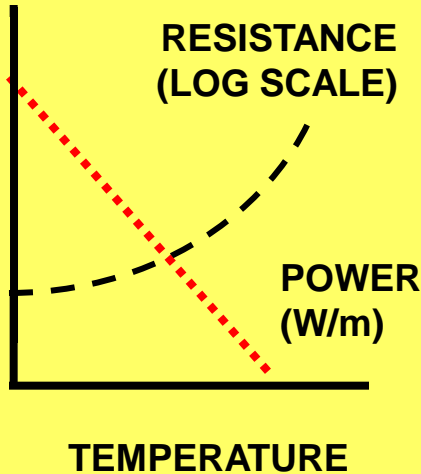
At low temperatures there are many conductive paths, allowing higher level of current to flow between the bus wires.

At high temperature the polymer expands, reducing the number of paths – thereby reducing the power output of the cable

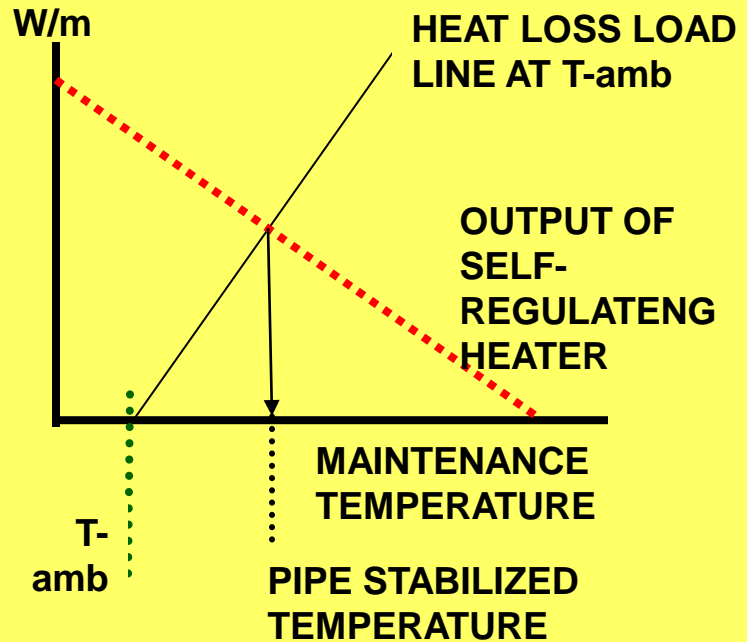
On cooling, conductive paths regroup, thereby increasing the power output – **ELASTIC MEMORY**



Self-Regulating Self-Limiting



Resistance Increases with temperature. – ‘Positive temperature Coefficient’ (PTC)

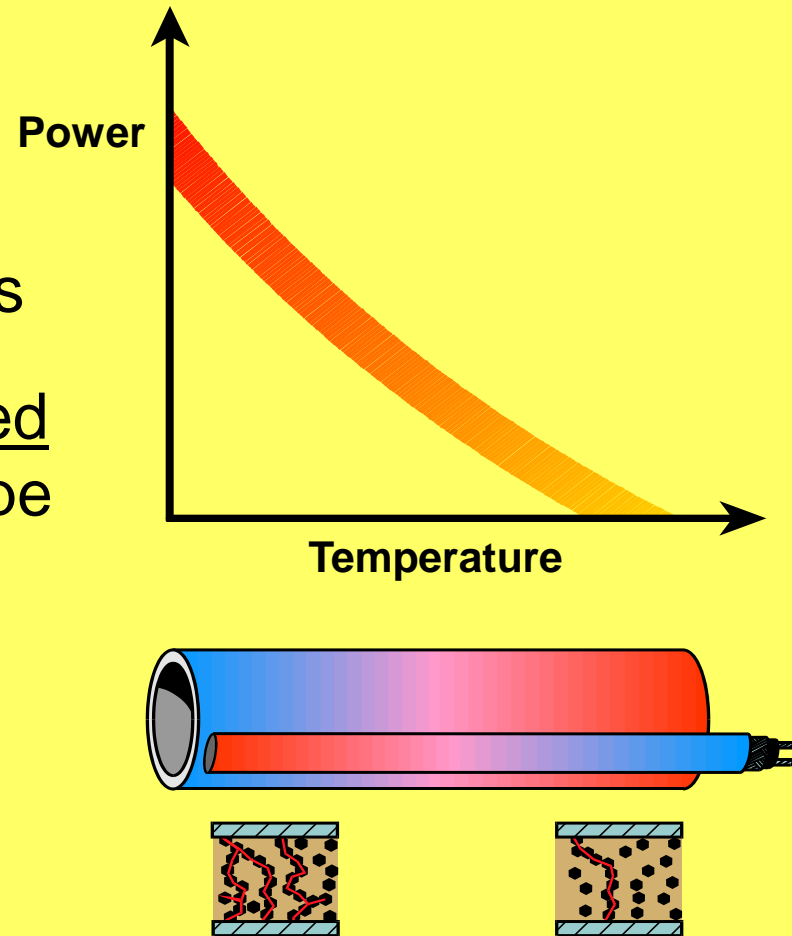


Equilibrium self-stabilized safe temperature condition is reached, without external controls.

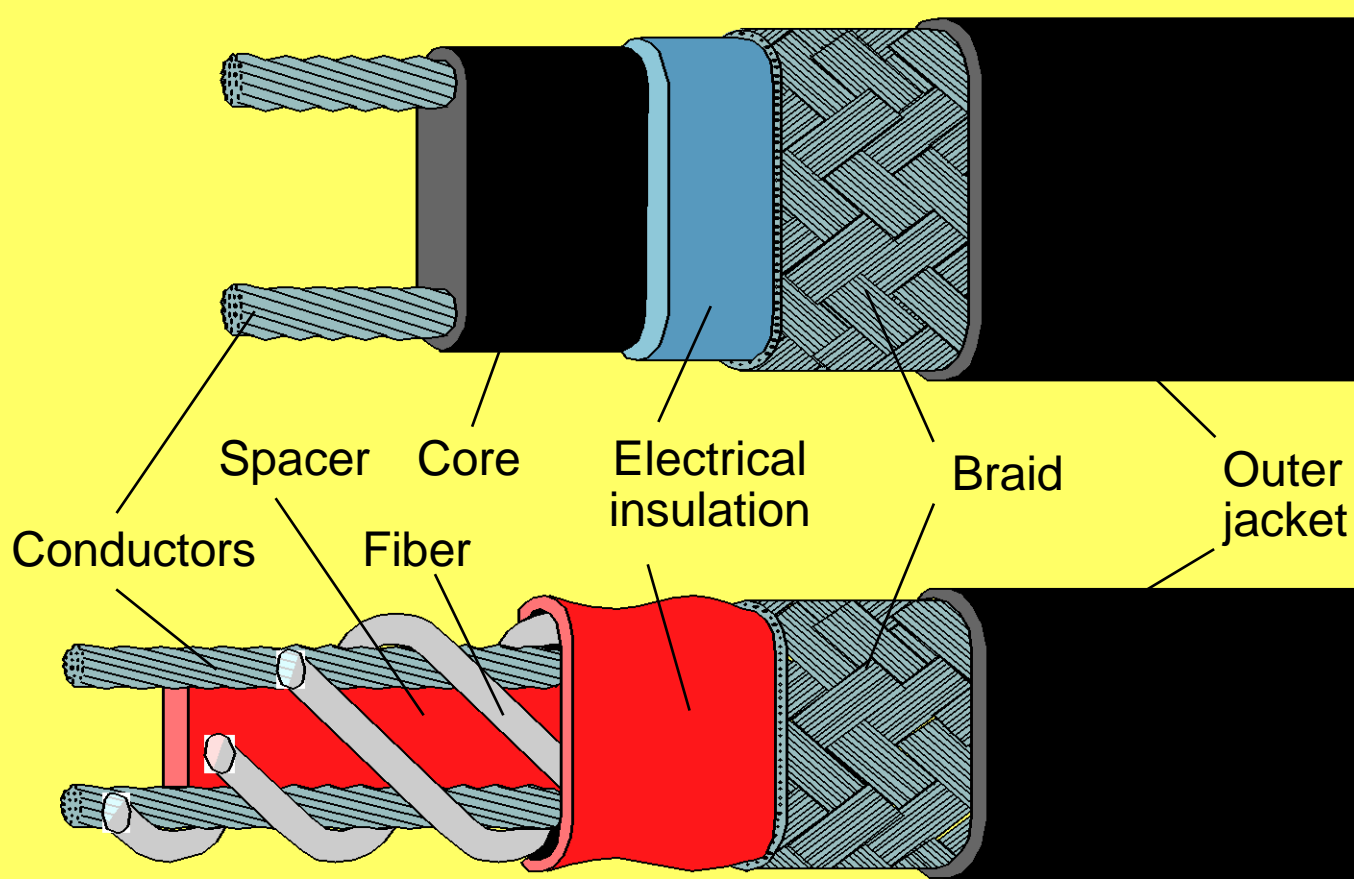
Self-Regulating Technology

Power output varies with temperature: as pipe temperature increases, power output decreases

The right amount of heat is supplied to the pipe: cold sections of the pipe get more heat input, whilst warm sections of the pipe get less heat input. ***Provides heat where and when needed.***



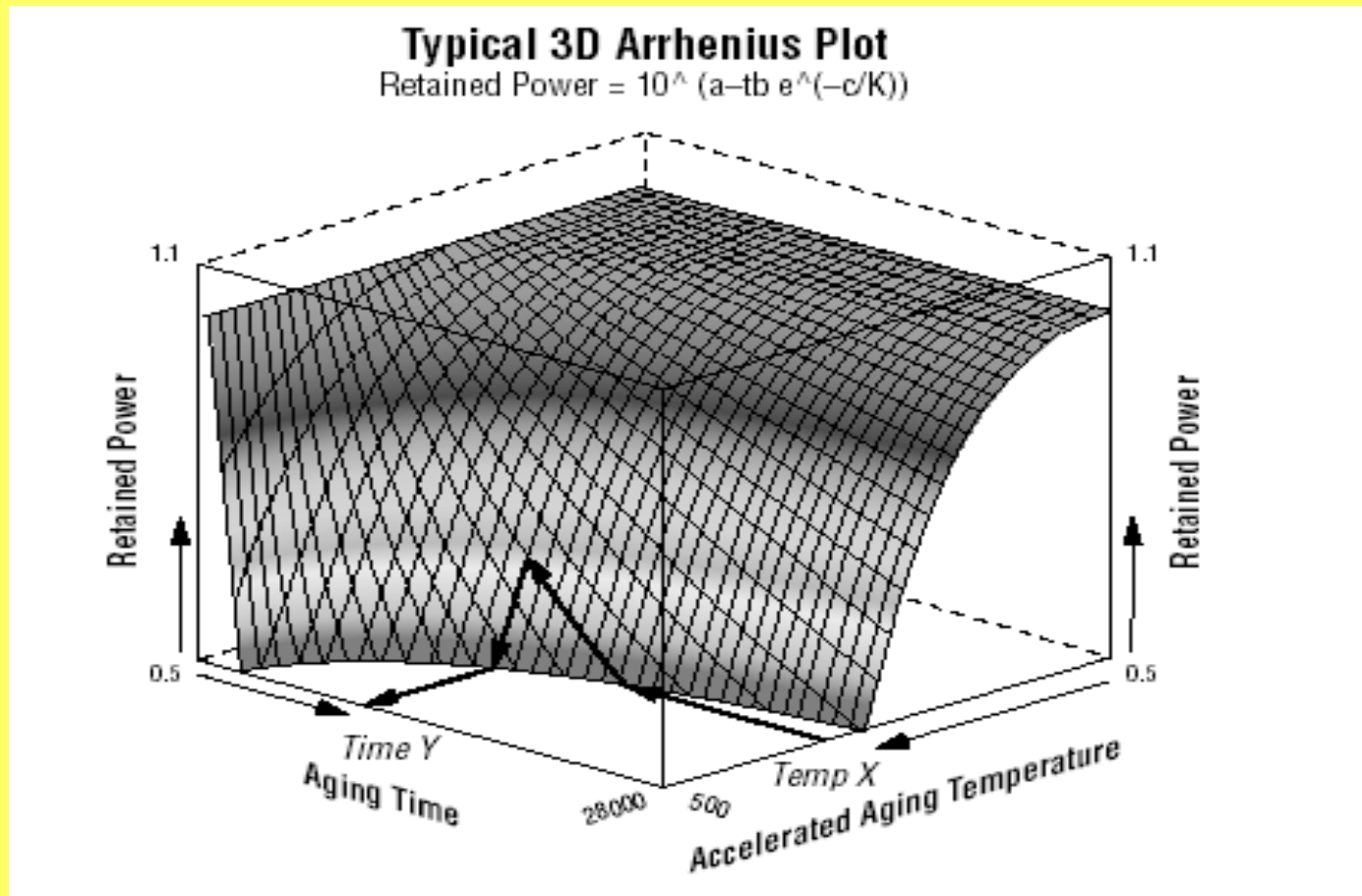
Constructions of Self-Regulating Trace Heating Cable



Properties of Self-Regulating Trace Heat Cable

- **Parallel construction: Cut-to-any-length**
- **Cross linking technology**
- **Power varies with Pipe & Ambient temp.**
- **Low Cross-over temp; NO BURNOUT**
- **Unconditional T-rating, Haz. Area Safety**
- **Operating Life >20 to 40 years.**

Life Now Evaluated With Modern 3-D Statistical Tools



Legionella - Entrepreneurship Opportunities

- Legionella detection laboratory and field testing services.
- Legionella Cleaning and Disinfection specialised services.
- Trace heating designs, material supply, installation and maintenance service.
- Temperature monitoring devices, design, and services.
- Thermo Mixing Valves, Heated Showers.
- New Plumbing and Thermal insulation materials.

ASHARE Std. 188P, 'Prevention of Legionellosis Associated with Building Water Systems', William F. McCoy, PhD,

Why is the prevention of legionellosis necessary?



Legionellosis

ASHARE Std. 188P, 'Prevention of Legionellosis Associated with Building Water Systems', William F. McCoy, PhD,

Legionellosis

By The Numbers

120,000 **People Died in
30 ears**

The approximate number of people who have died from legionellosis in the US since the cause of the disease and how to prevent it was determined 30 years ago

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Legionellosis

By The Numbers

34,000 **\$/Case**

The number of direct healthcare dollars
it costs in the US to treat
a single case of legionellosis

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Legionellosis

By The Numbers

217%

**Increase in
a Decade**

Increase in annually reported U.S. legionellosis cases from 2000-2009.
Officially reported incidence rate has tripled in this decade.

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Legionellosis

By The Numbers

12 \$ /\$ HC Cost

The number of dollars of indirect cost
for every direct healthcare dollar
spent on pneumonia due to
missed time, disability and lost productivity

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Legionellosis

By The Numbers

Several Billion \$ /annum

The annual cost in dollars to the US
economy due to legionellosis
Every year!

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Legionellosis

By The Numbers

193 million **\$ Jury award**

The largest dollar jury award (so far) for gross negligence and other failures in a case of legionellosis that resulted in long-term disability and severe debilitation

The case was not fatal

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Dubai World sued in \$337.5m Legioni

ARTICLE

By Claire Ferris-Lay Thursday, 25 August 2011 10:57 AM

FACEBOOK



CityCenter Holdings is a joint venture between MGM Resorts and Dubai World

Dubai World and MGM Resorts, joint owners of the Las Vegas CityCentre complex, are being sued for \$337.5m by eight former hotel guests who claim they were exposed to legionnaire's disease during their stay.

Legionella – Whose Responsibility?

Legionnaires' disease is an environmental disease and an environmental issue, with safety and health responsibilities to be addressed by many. Regulatory system, penalties and labour laws are to be in place. Owners' should be aware of their Responsibility. Risk assessment management team to be formed comprising of Director, Infection Control, Facilities Manager & Engineer, Facilitator and equipment suppliers to share the responsibility.

***Legionella*.-Thank You.**

What is the “Re-active Approach?”

**“If you don’t look for it,
you won’t find it.**

**If you don’t find it, you
don’t think you
have a problem.**

**If you don’t think you
have a problem,
you don’t do anything
about it”.**

