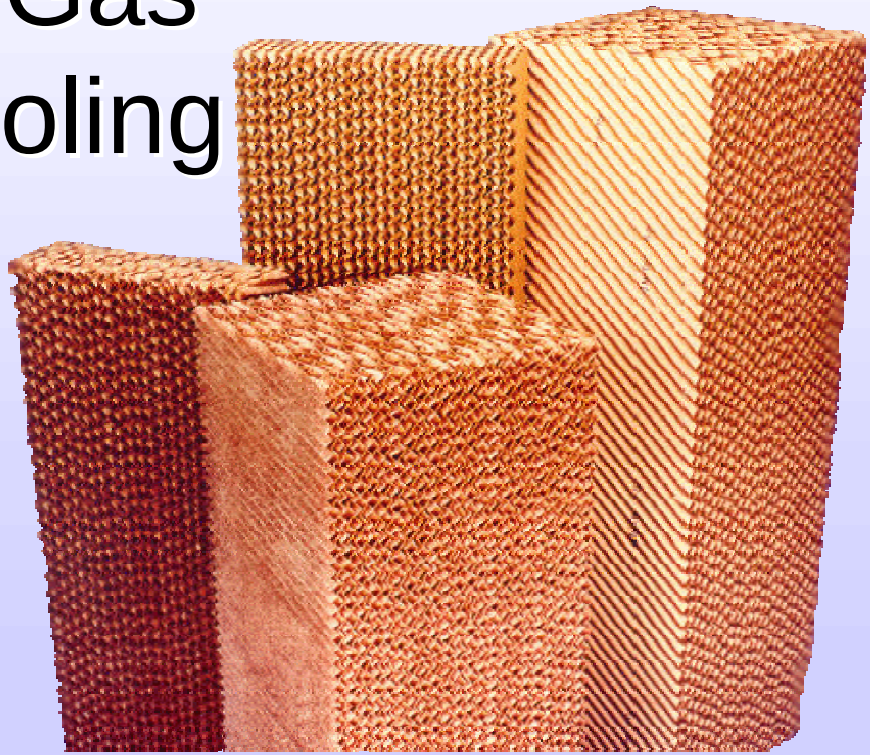
Evaporative Cooling Technology for Gas Turbine Inlet Cooling



ASME Turbo Expo 2011

Presented by:
Annette Dwyer
Munters Corporation

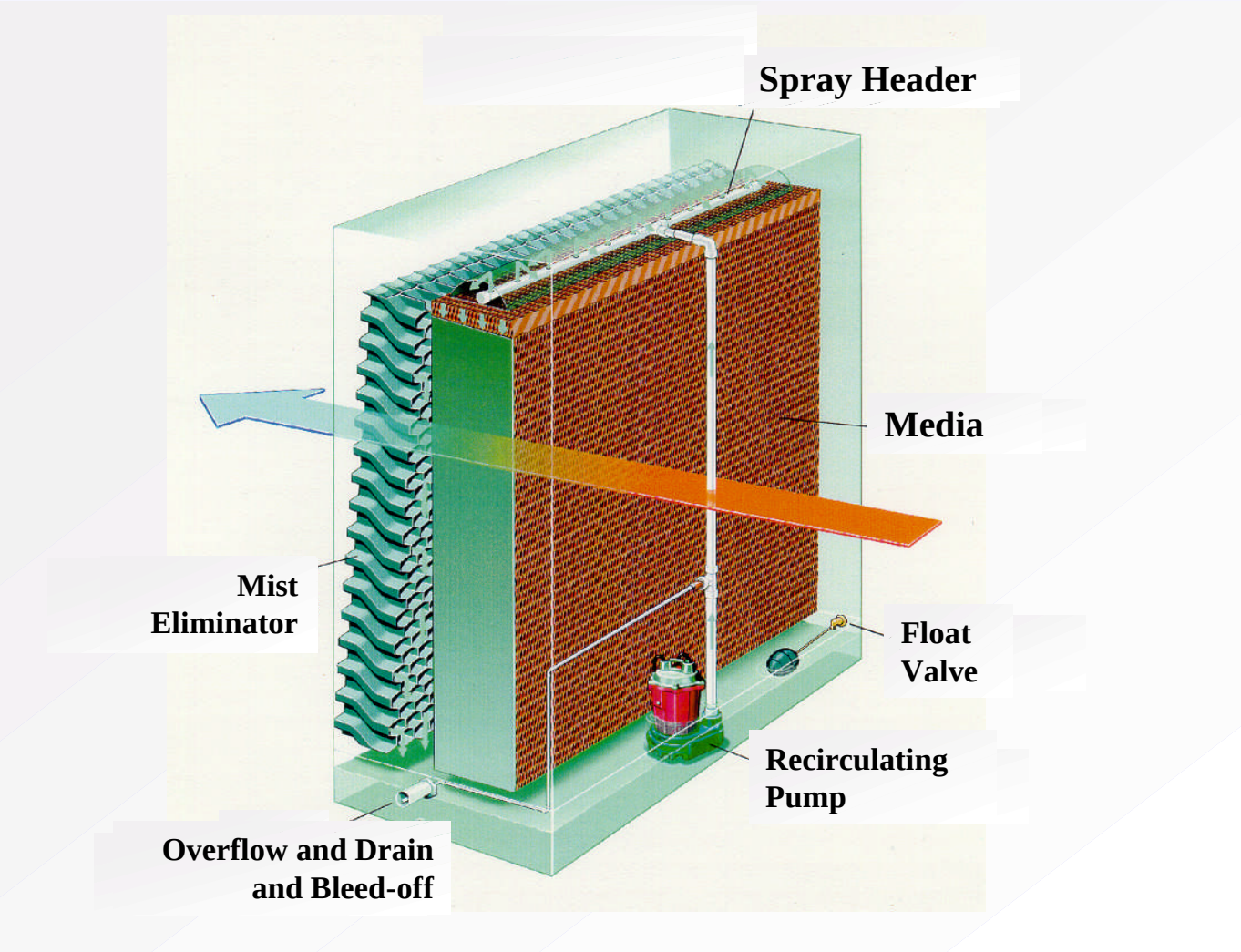
Munters

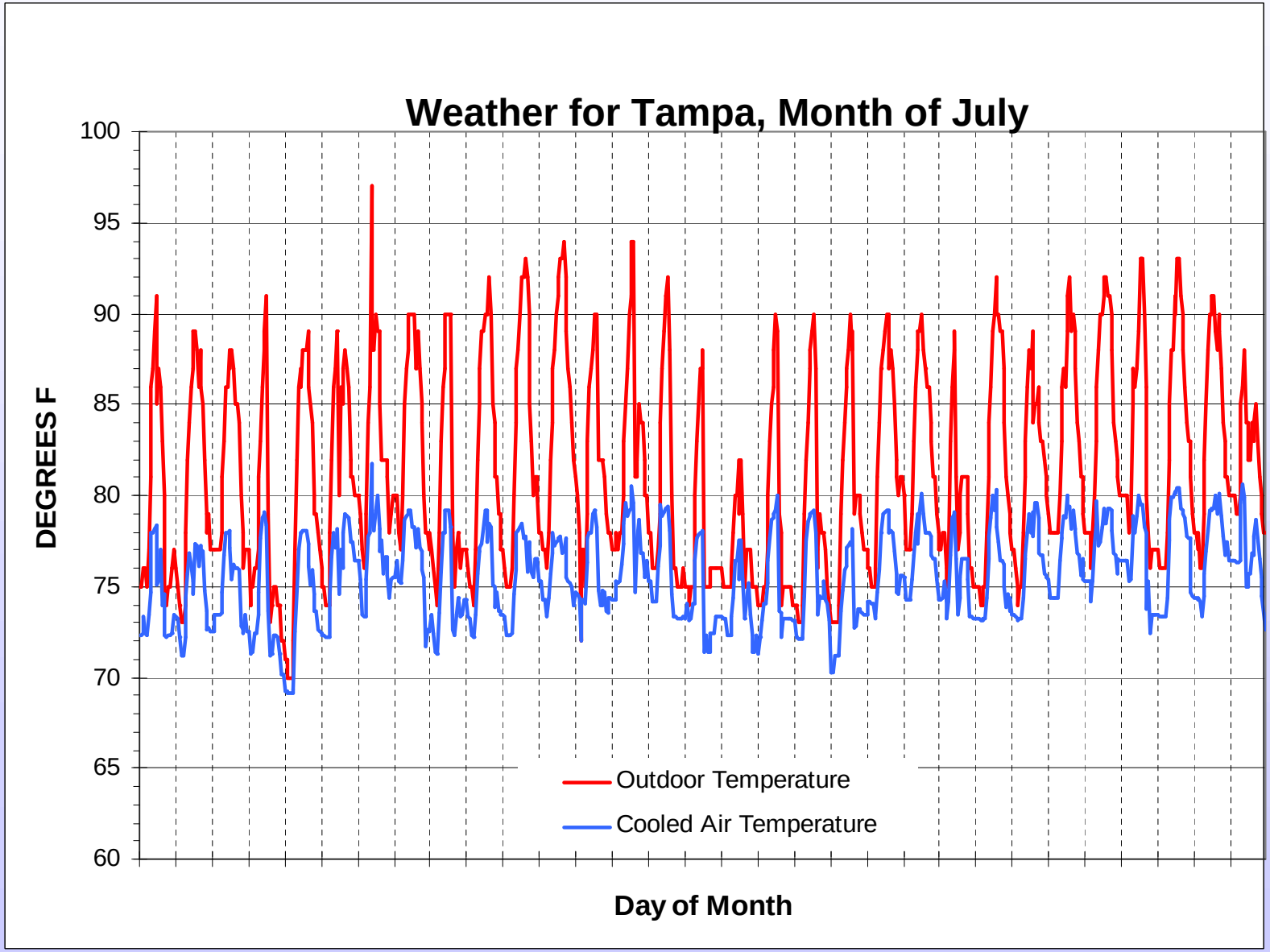
TURBINE INLET COOLING ASSOCIATION turbineinletcooling.org

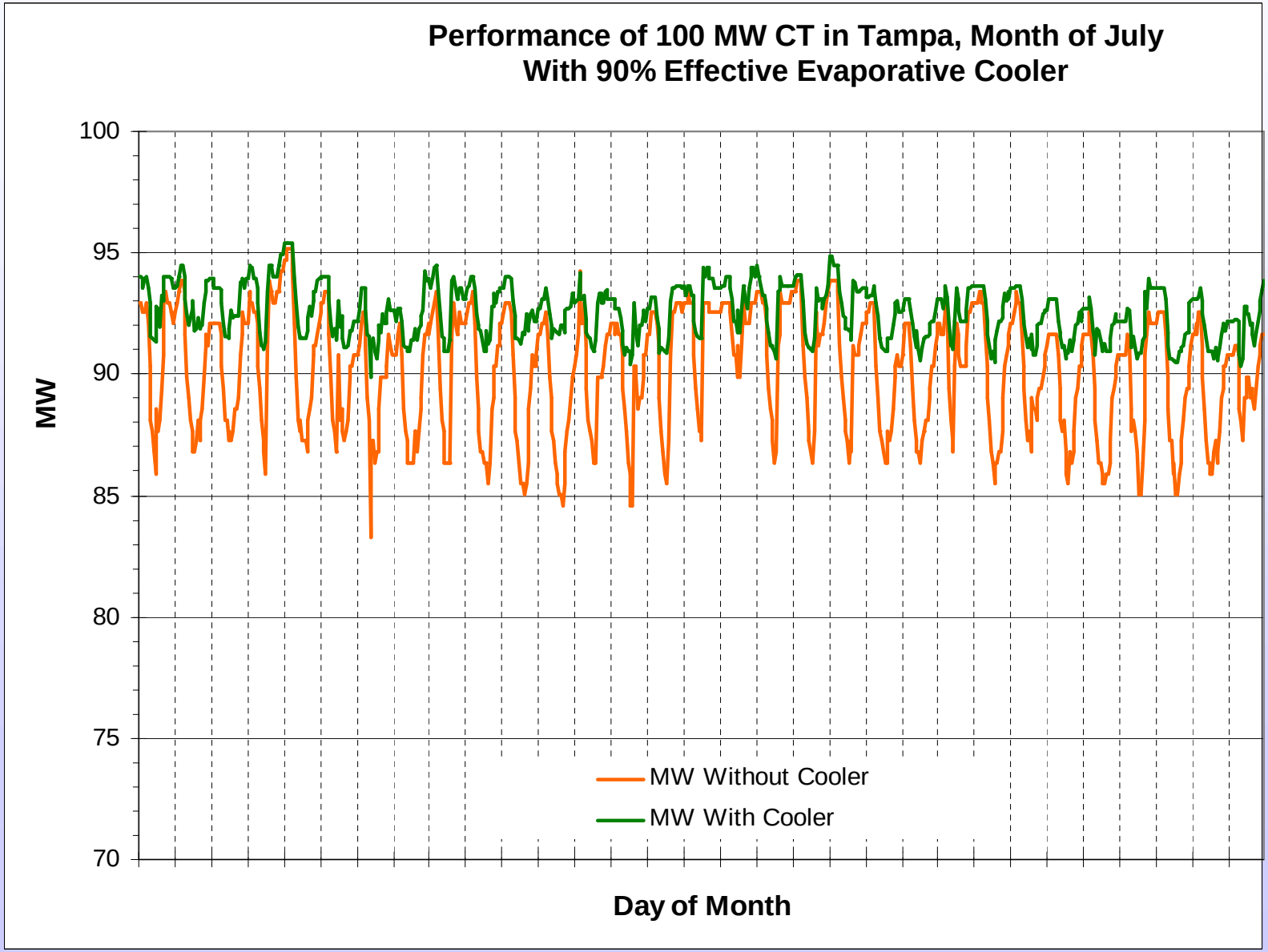
Advantages of Evaporative Cooling Systems

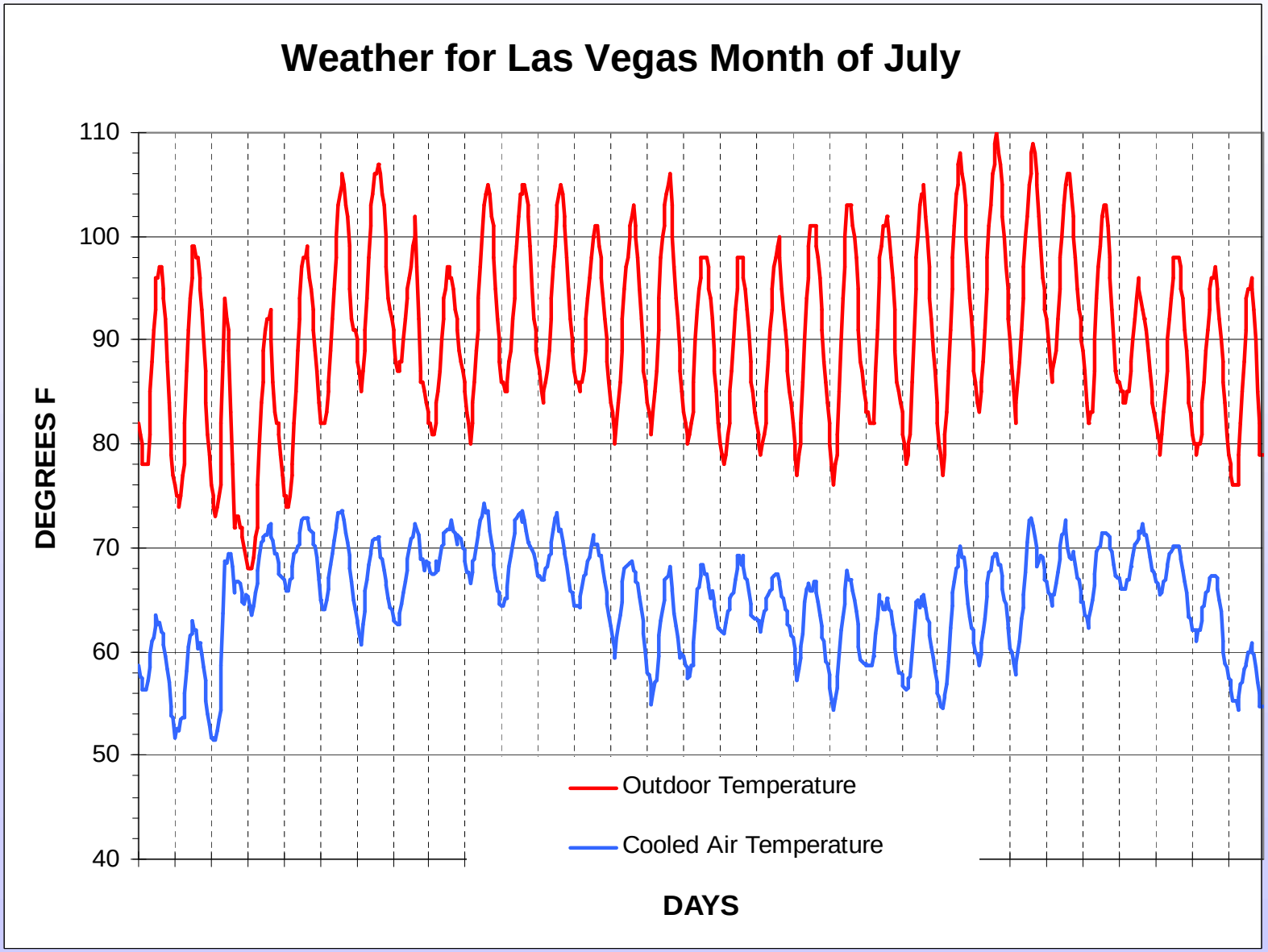
- Proven Technology with more than 2,000 Installations since 1975
- Low Water Usage
- High System Efficiency
- Simple Low Maintenance System
- Low Operating Costs
- Low Initial Investment - Short Pay Back Period
- Enhanced Air Filtering and Sound Reduction Properties

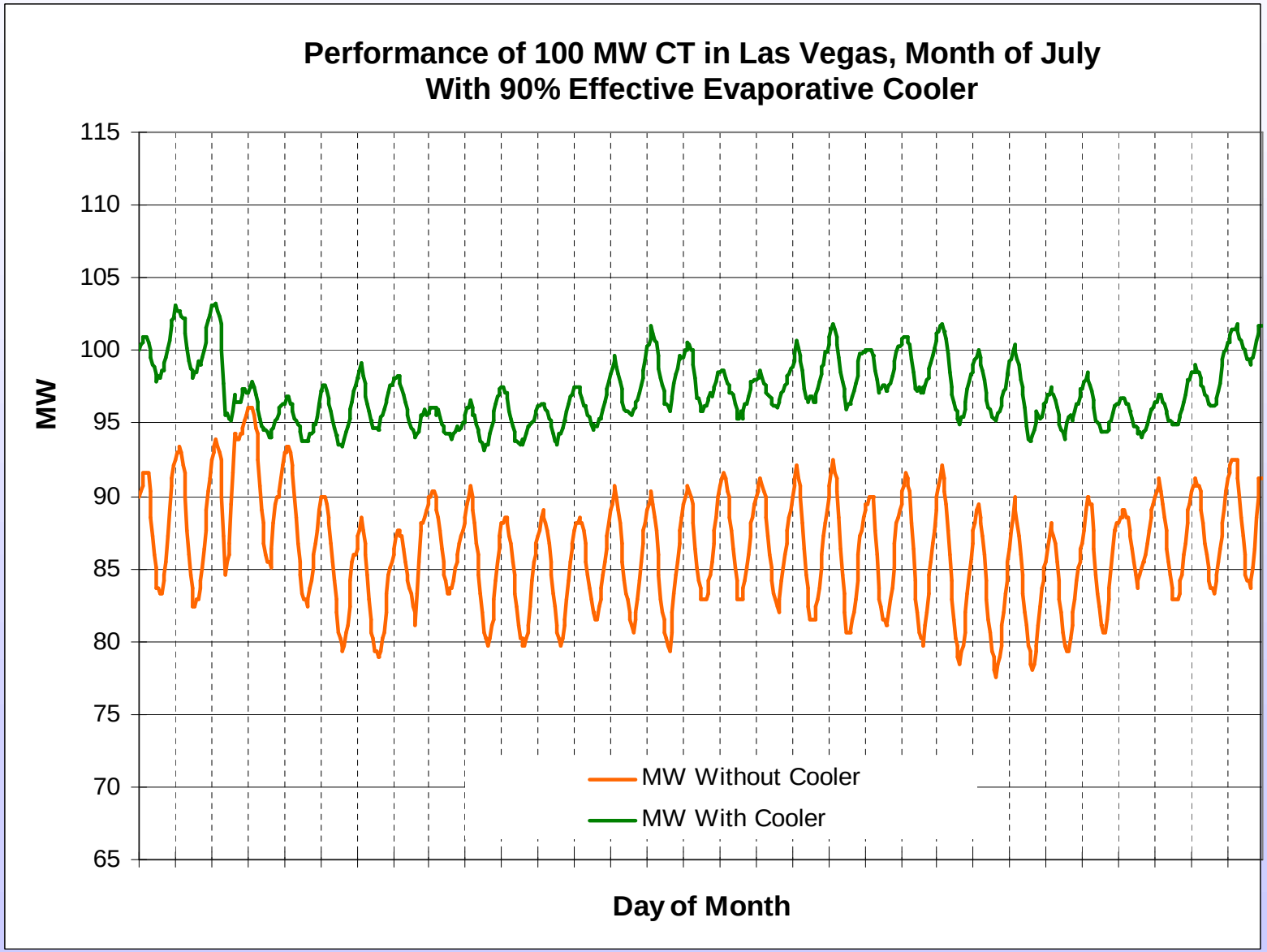
Evaporative Cooler Components




Weather for Tampa, Month of July
DEGREES F
100
95
90
85
80
75
70
65
60
Day of Month
Outdoor Temperature
Cooled Air Temperature

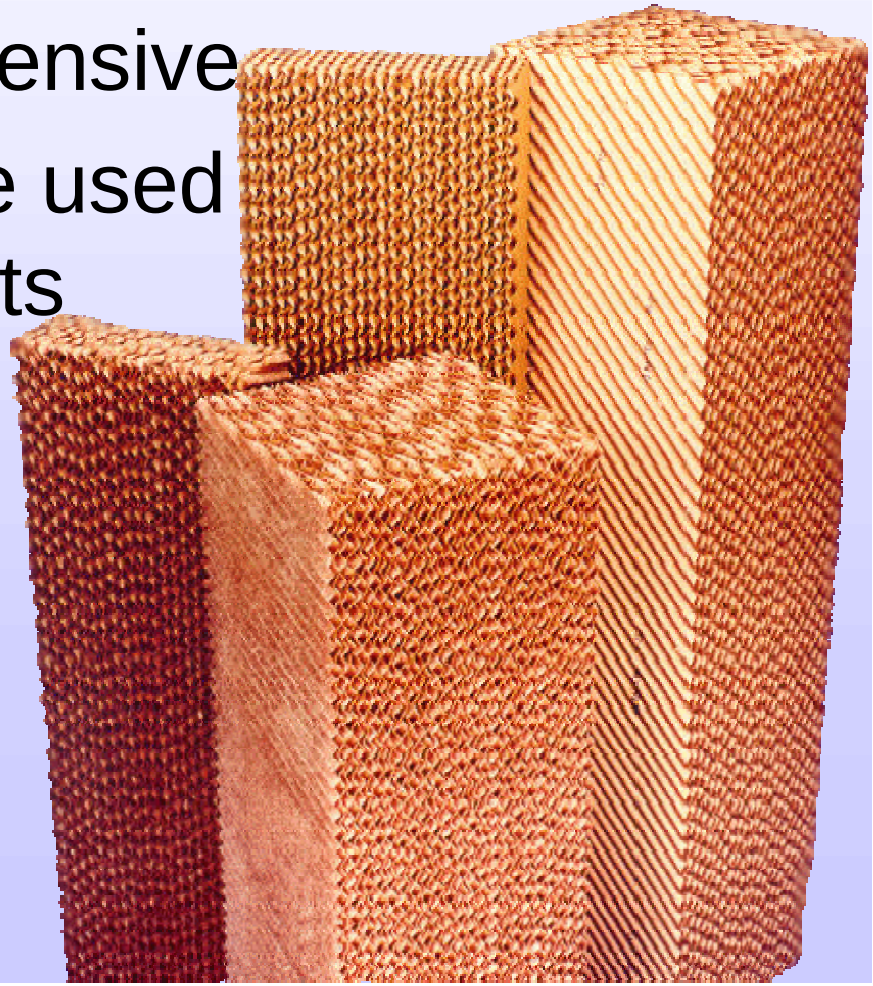

Performance of 100 MW CT in Tampa, Month of July
With 90% Effective Evaporative Cooler
100
95
90
85
80
75
70
MW
MW Without Cooler
MW With Cooler
Day of Month


Weather for Las Vegas Month of July
110
100
90
80
70
60
50
40
DEGREES F
Outdoor Temperature
Cooled Air Temperature
DAYS


Performance of 100 MW CT in Las Vegas, Month of July
With 90% Effective Evaporative Cooler
MW
115
110
105
100
95
90
85
80
75
70
65
MW Without Cooler
MW With Cooler
Day of Month

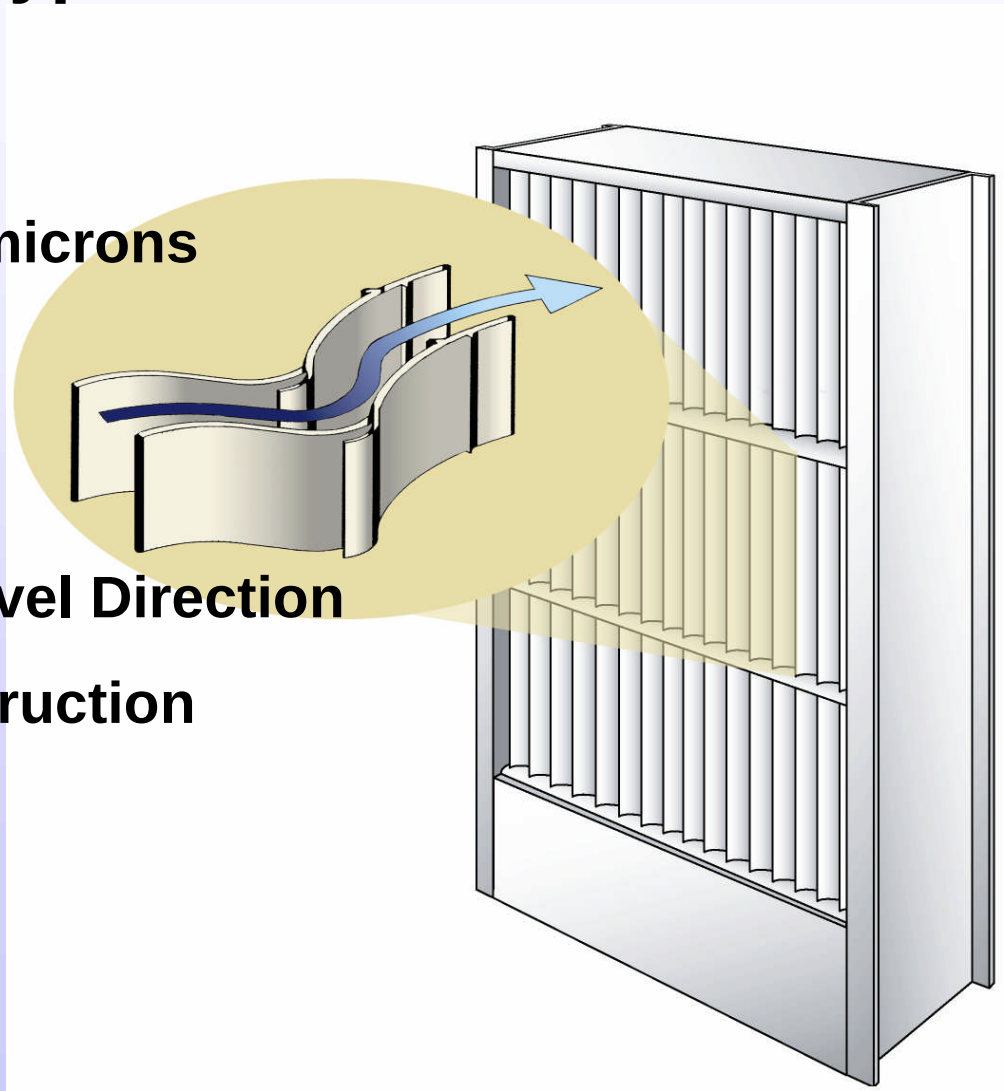
Different Media Available

- Cellulose – rugged, tolerant to harsh conditions, inexpensive
- UL Fire rated – Must be used in high risk environments
- High Efficiency – Best for high velocity applications.



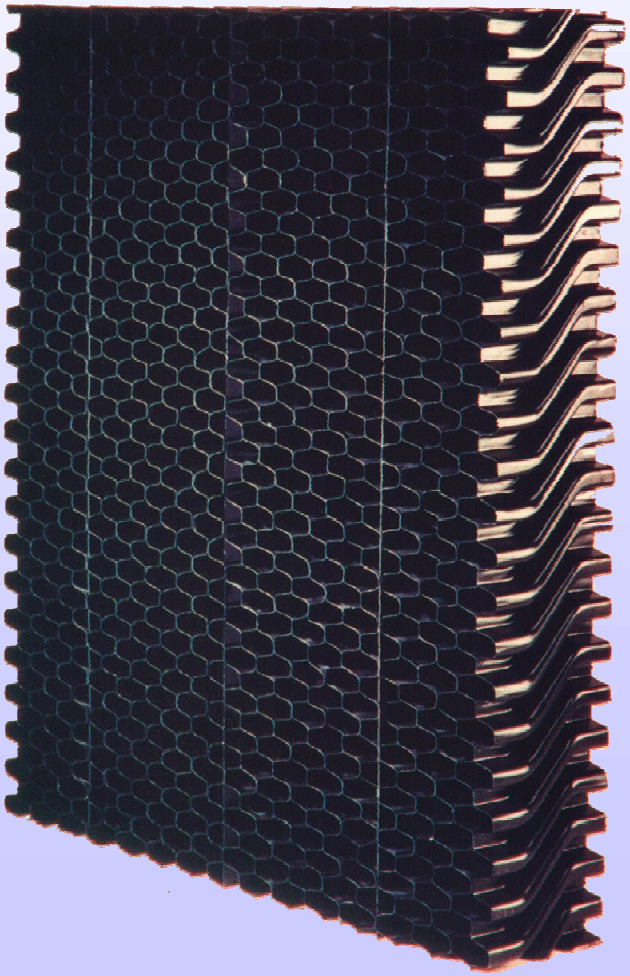
Vane Type Mist Eliminators

- Highest Efficiency, 25-30 microns
- Wide Velocity Range
- Low Pressure Drop
- Need Less room in Air Travel Direction
- Light weight Plastic Construction

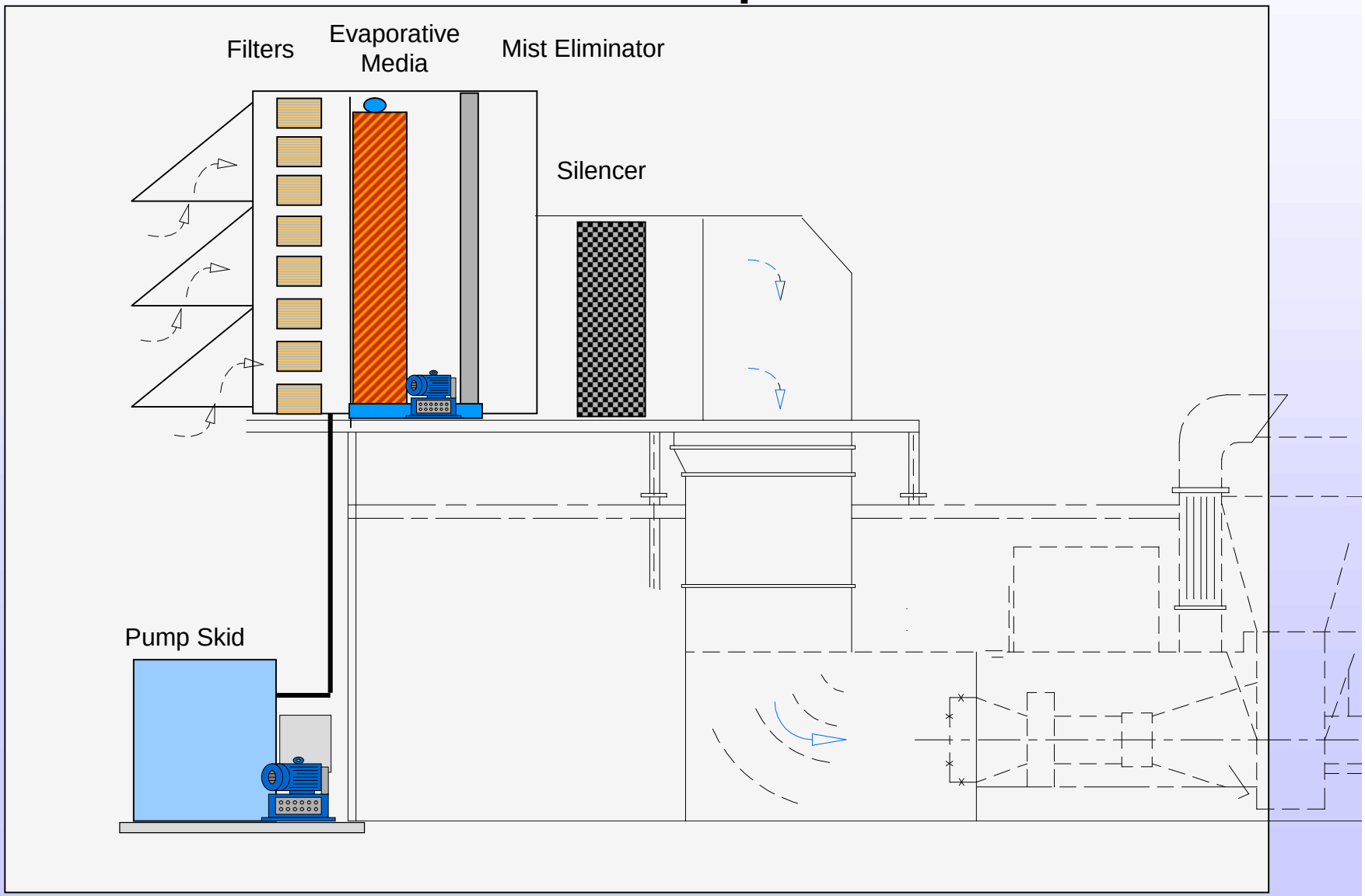


Cellular Mist Eliminators

- Lightweight PVC Construction
- Excellent Droplet Separation
  45µ and Larger
- Easy to Install
- Easily Removed for Maintenance
- Very Low Pressure Drop



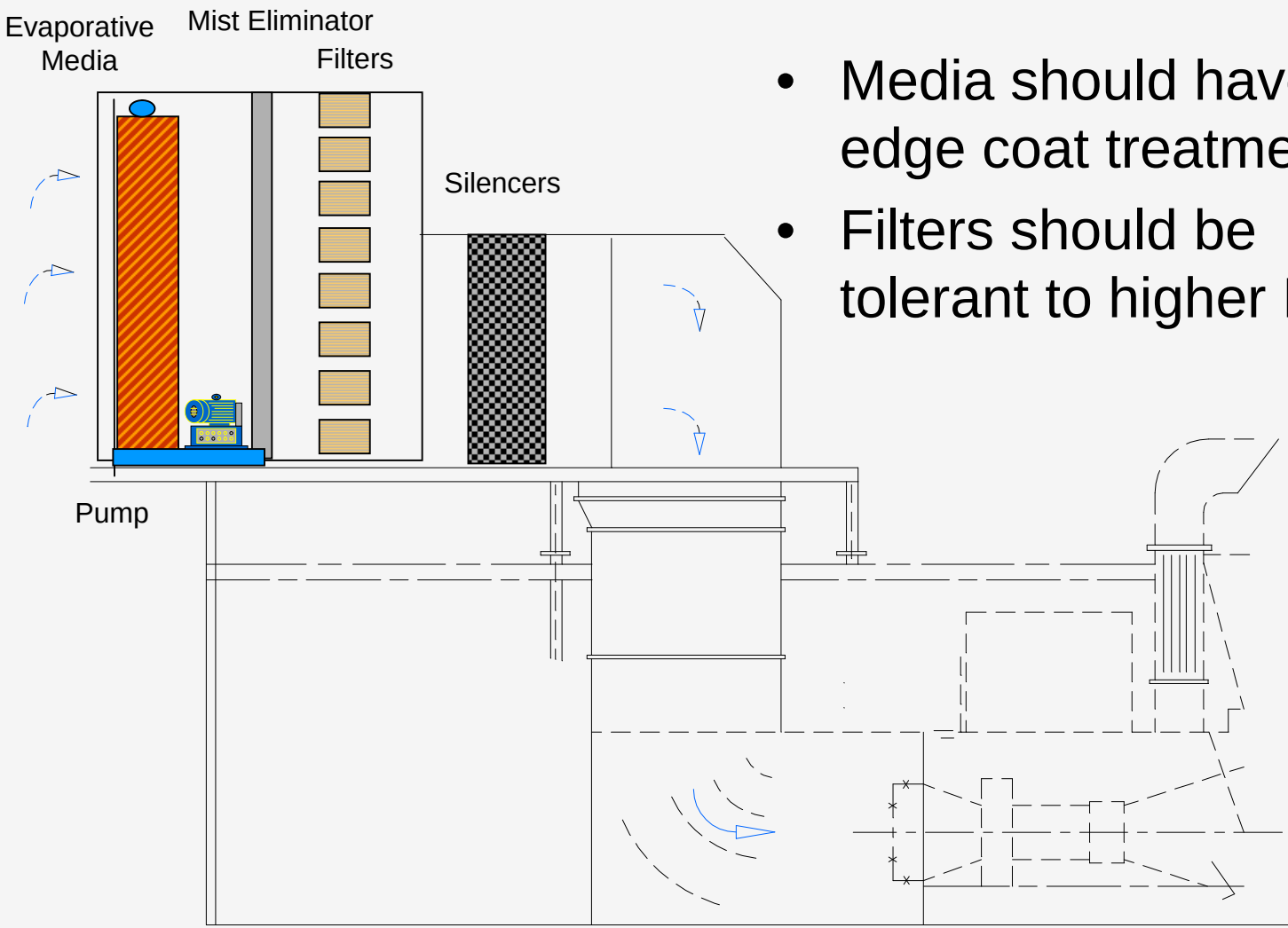
Location of the Evaporative Cooler




7 19:29


28 16:3

Media Upstream of Filters



- Media should have edge coat treatment
- Filters should be tolerant to higher RH

Media Water Treatment

- Continuous bleed/ and or quarterly flush and dump used for scale control
- Scale inhibitors not recommended
  - Bleed is major method of control
- Biocides not recommended
  - No oxidizing biocides allowed
- Corrosion inhibitors not recommended
  - all SS and plastic construction

Water Treatment Options for Scale

Reverse Osmosis	High Cost High Maintenance cost Minimal Bleed off
Demineralization	High Cost Requires handling chemicals Minimal Bleed off
Zeolite Softening	Changes Calcium Carbonate to Sodium Carbonate Does not remove Silica Requires bleed-off
Acid Addition	Typically use concentrated sulphuric acid Makes Calcium and Magnesium less soluble Requires continuous injection of acid Dangerous to handle/ can add too much acid Requires bleed-off
Crystal Modifiers	Requires continuous injection of chemical Leaves a soft sludge residue that can blow downstream
Sequesterants	Require addition of sodium hexametaphosphate Encourages algae growth

High Purity Water

High purity water such as RO or demineralized water can be used in media based evaporative.

1. Blend with raw water to establish suitable quality water and bleed rate.
2. Use pure RO or De-min water

- Do not use a bleed – off
- Clean debris from sump commensurate with the contaminant loading from the air

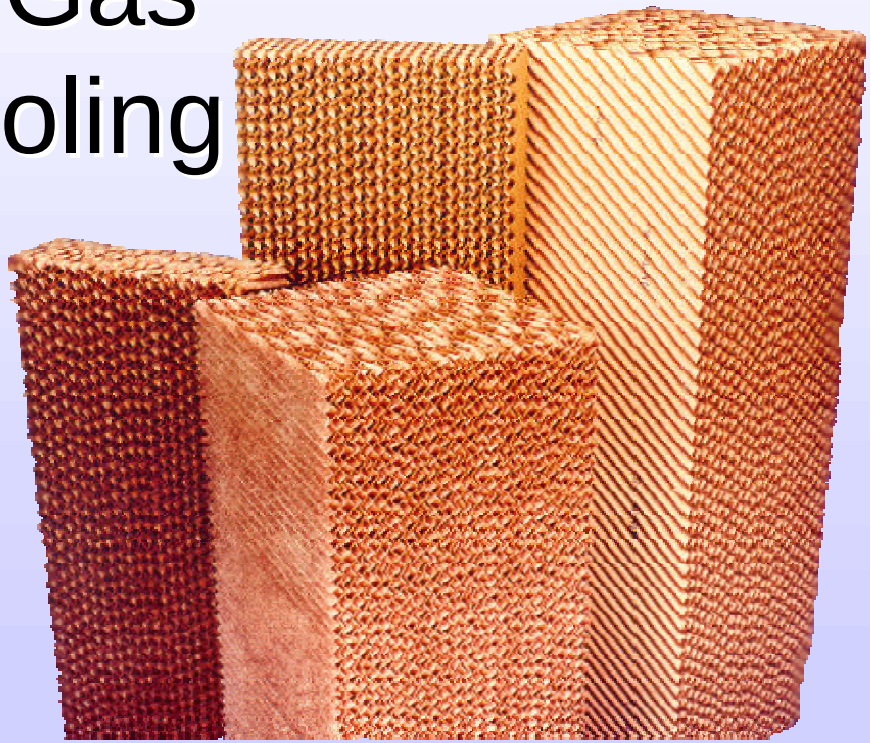
Utilities Example for 100 MW CT in Las Vegas

	Media	Fog	Mechanical Chilling
Deg of Cooling	37 F	39 F	57 F
Water Evaporated	35 GPM	37 GPM	76 GPM (at Cooling Tower)
Blow Down	12 GPM	18 GPM (at RO plant)	4 GPM
Parasitic Power Loss	10 kW	75 kW	2250 kW
Insertion loss	0.3”wg	0.05”wg	1.0”wg

Utilities Example for 100 MW CT in Tampa, FL

	Media	Fog	Mechanical Chilling
Deg of Cooling	12.6 F	13.3 F	44 F
Water Evaporated	13 GPM	13.6 GPM	136 GPM (at Cooling Tower) 52 GPM condensed
Blow Down	4 GPM	6.5 GPM (at RO plant)	4.5 GPM at Cooling Tower
Parasitic Power Loss	10 kW	27 kW	3181 kW
Insertion loss	0.3”wg	0.1”wg	1.0”wg

Evaporative Cooling Technology for Gas Turbine Inlet Cooling



ASME Turbo Expo 2011

Presented by:
Annette Dwyer
Munters Corporation

Munters

TURBINE INLET COOLING ASSOCIATION turbineinletcooling.org