
Seawater Heat Exchangers

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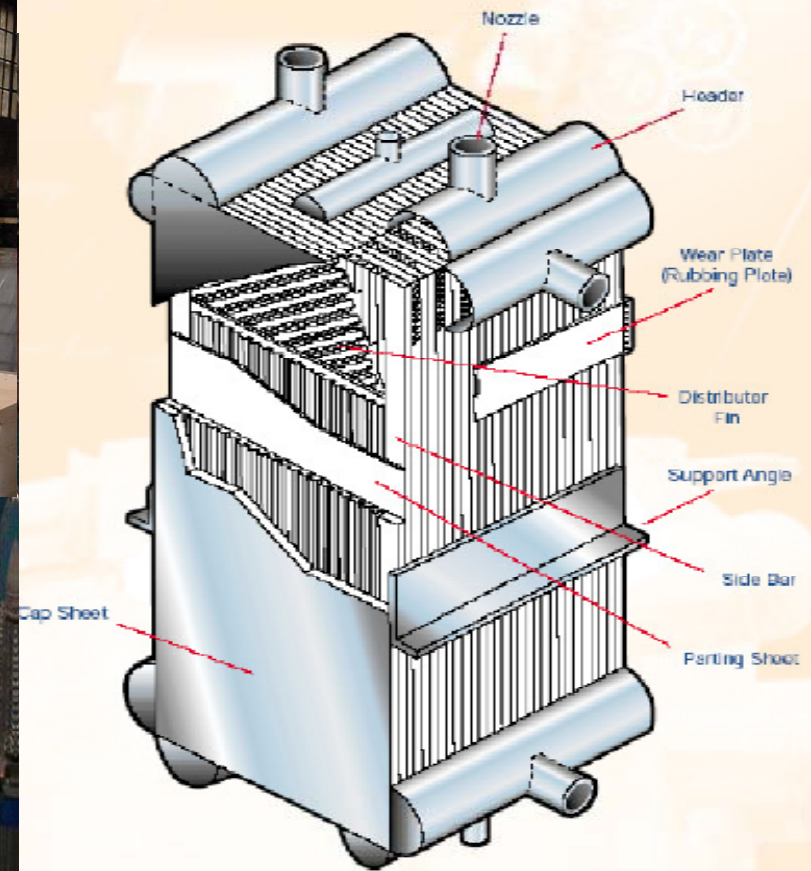
ME Department – UMD

CRRC- NOAA OTEC Technology Workshop

University of New Hampshire

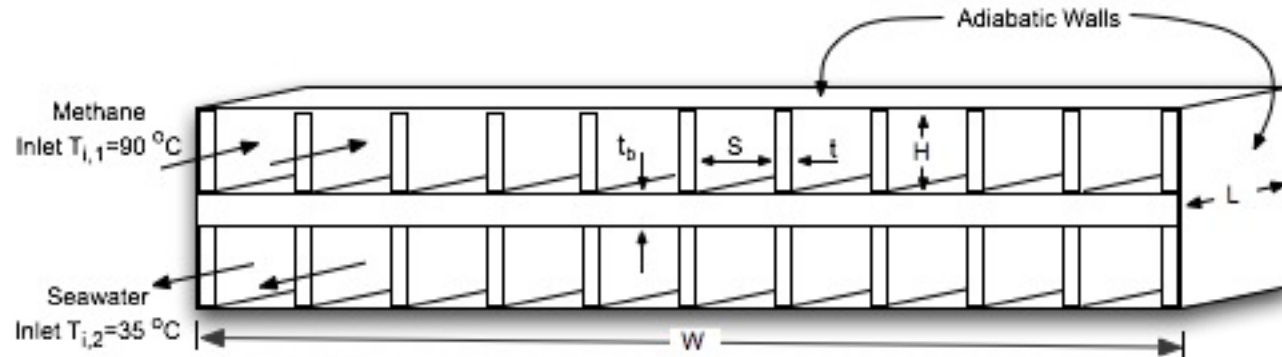
November 2009

Heat Exchanger Technology



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Heat Exchanger Fundamentals



$$q = UA \Delta T_{lm} \quad \Delta p = \left(f \frac{L}{D_h} + K_{L,entry} + K_{L,exit} \right) \frac{\rho U^2}{2}$$

$$UA = \frac{1}{\frac{1}{n_o A_{t,m} h_m} + \frac{t_b}{k A_b} + \frac{1}{n_o A_{t,w} h_w}}$$

$$f = f(Re, l/D, \epsilon/D)$$

$$h = h(Re, Pr, l/d, k)$$

Seawater Heat Exchanger Issues

- **Applications**

 - OTEC, desalination, coastal powerplants, gas/oil processing

- **Corrosion Resistance**

 - titanium, copper-nickel, aluminum, plastics, ceramics, (coatings)

- **Biofouling**

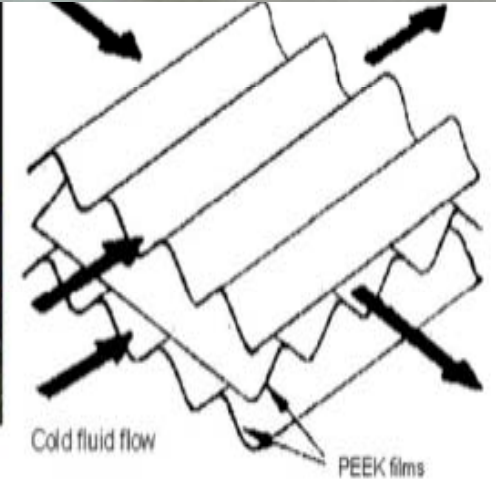
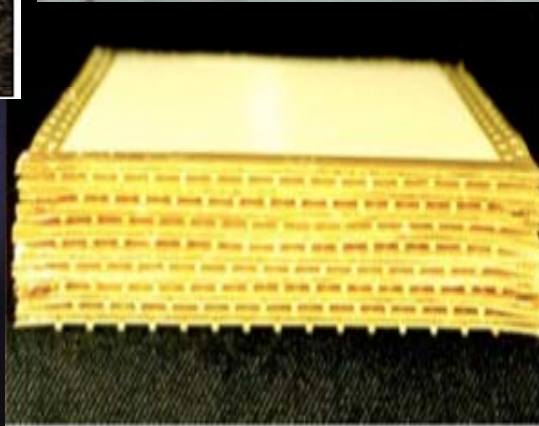
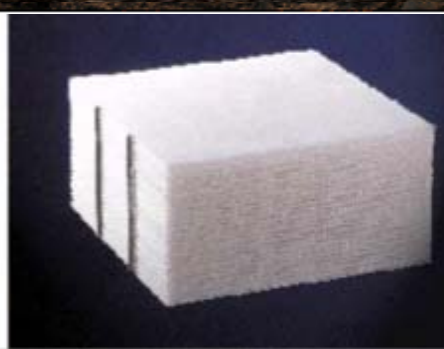
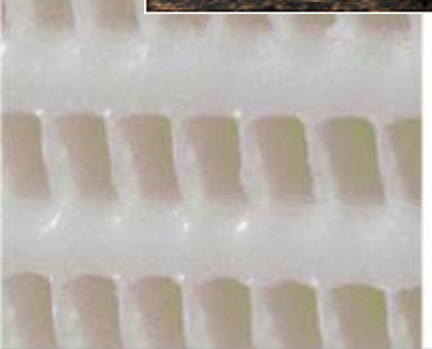
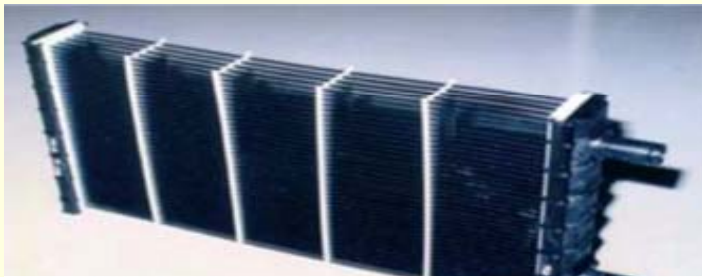
- **Thermal Conductivity**

- **Density**

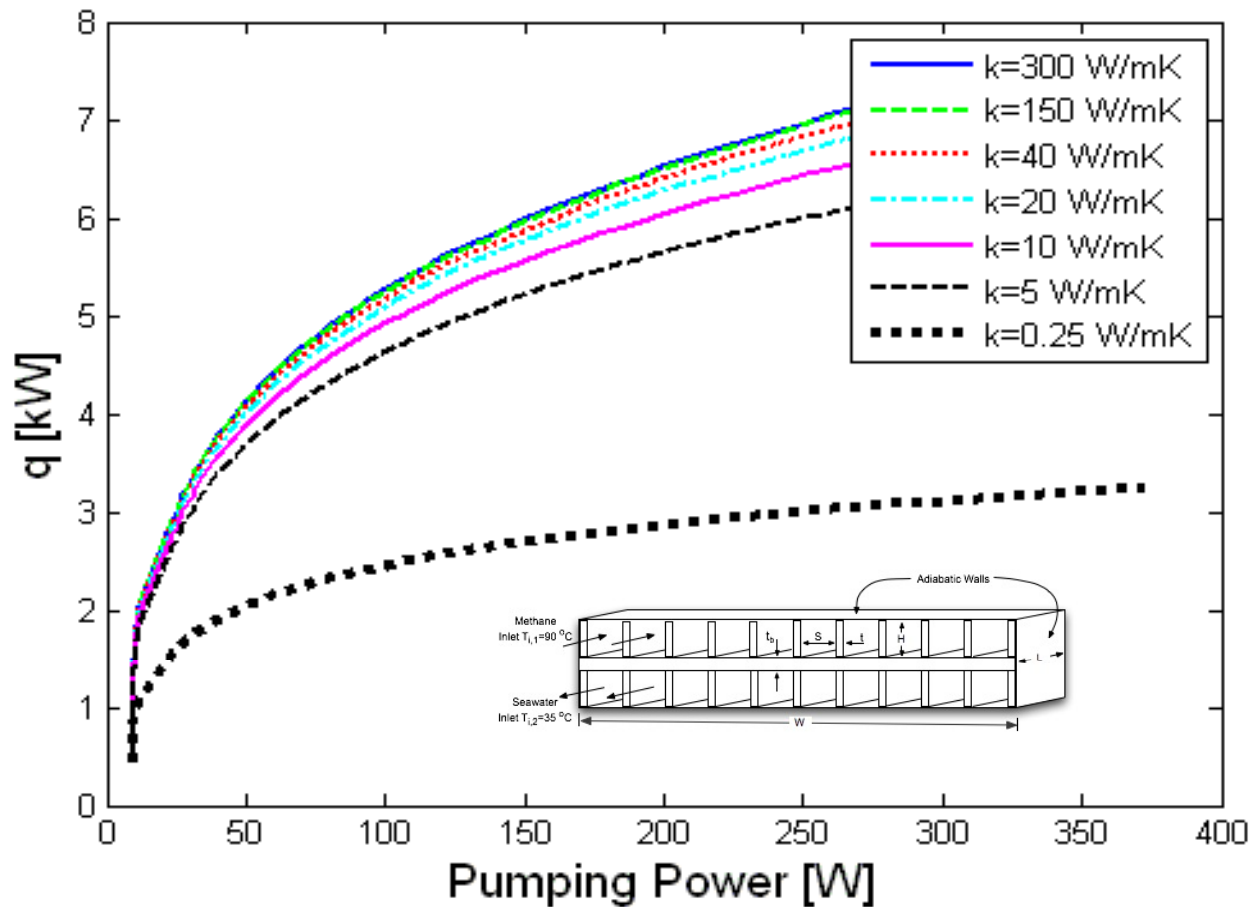
- **Material Cost**

- **Manufacturability; Manufacturing Cost**

Polymer Heat Exchangers

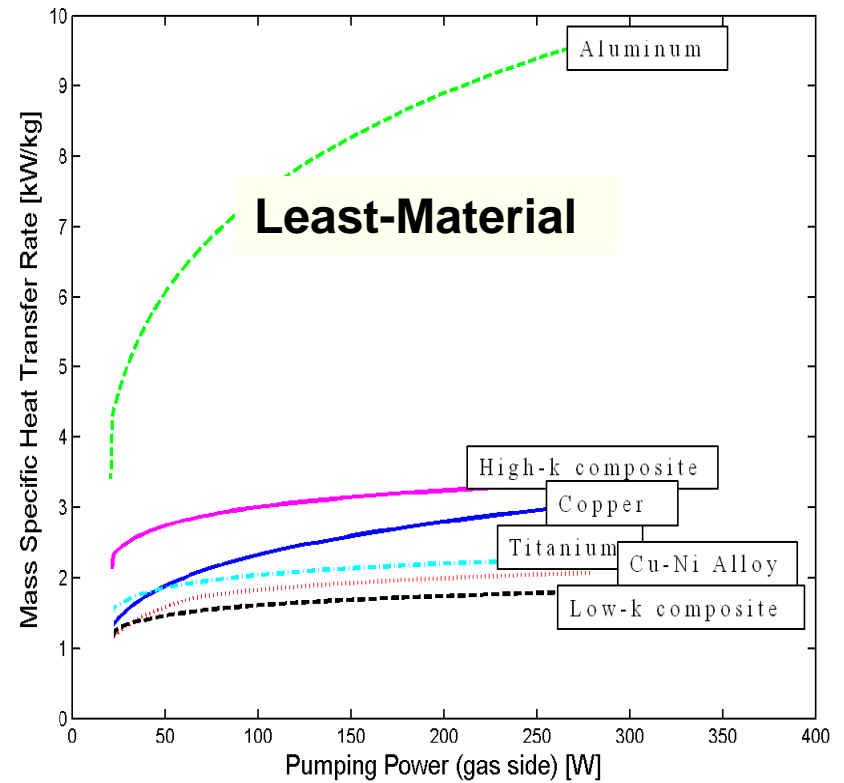
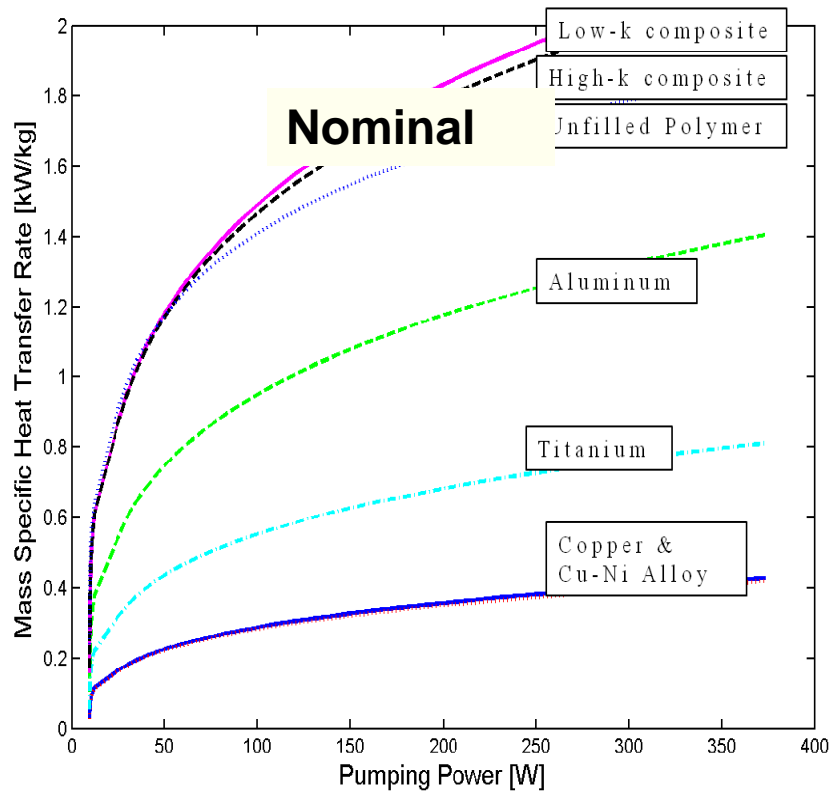


Material Conductivity Effect



$W=L=1\text{ m},$
 $H_{\text{fin}}=10\text{ mm},$
 $t_f=t_b=1\text{ mm}.$
 $\text{Vel Liq} = 1\text{ m/s},$
 $\text{Vel Gas} < 10\text{ m/s}$
 $N_{\text{fins,m}}=100,$
 $N_{\text{fins,w}}=5$

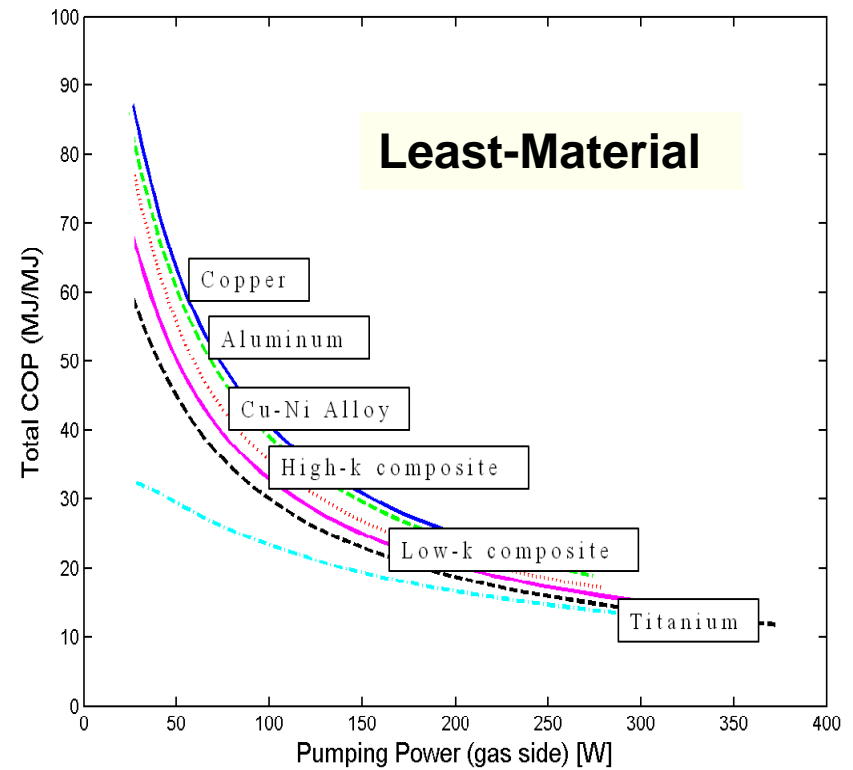
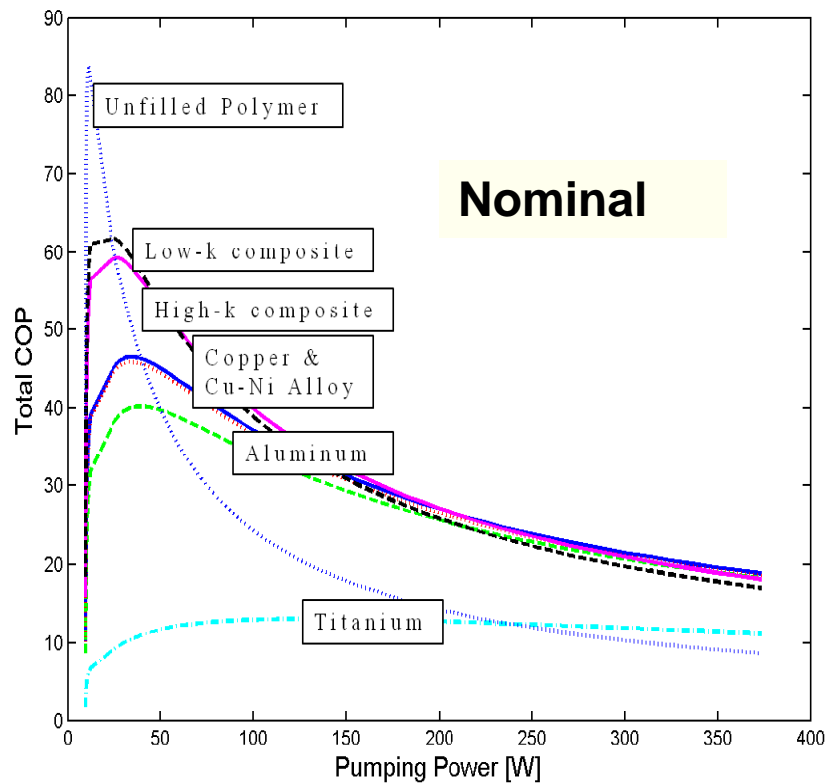
Mass-Specific Heat Transfer Coefficients



$W=L=1\text{m}$, $H_{\text{fin}}=10\text{mm}$, $t_b=1\text{mm}$, $Vel\ Liq = 1\ \text{m/s}$, $N_{\text{fins},g}=100$,
 $N_{\text{fins},l}=5$, $t_{\text{fin}} > 0.1\text{mm}$

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Total Coefficient of Performance



$W=L=1\text{m}$, $H_{\text{fin}}=10\text{mm}$, $t_p=1\text{mm}$, $\text{Vel Liq} = 1 \text{ m/s}$, $N_{\text{fins,g}}=100$,
 $N_{\text{fins,l}}=5$, $t_{\text{fin}} > 0.1\text{mm}$

Laboratory X-Flow PHX Prototype



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9