NUCAP:
Characterization Internal Heat Transfer for GRIP Metal Enhanced Tubes

Roger Kempers – Department of Mechanical Engineering, York University

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TF-LAB www.tf-lab.ca

LASSONDE SCHOOL OF ENGINEERING | YORK UNIVERSITÉ UNIVERSITY

Background & Objective

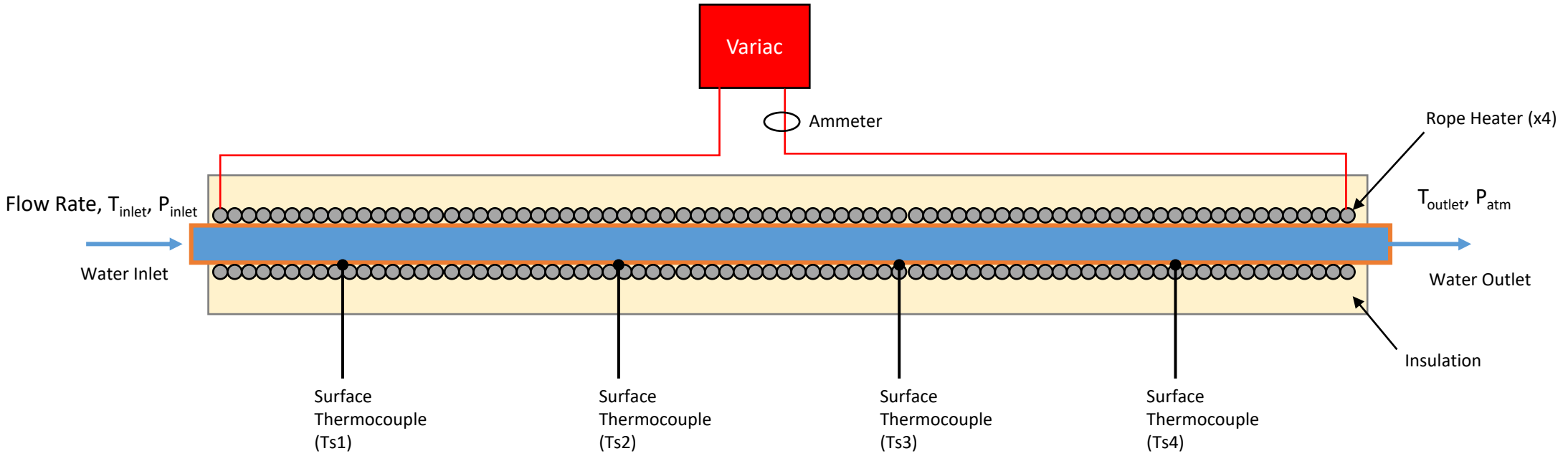
NUCAP Energy have developed a method for fabricating GRIP Metal features on the internal surfaces of tubes.

Objective

Characterize the effect of this enhancement on single-phase convective heat transfer by comparing a similar sized GRIP Metal enhanced tubes with an identical sized smooth tube.

Simple comparison test using water.

Experimental Apparatus



Average Convective Heat Transfer Coefficient, *h*, computed as:

$$h = \frac{Q}{A\left(T_{surface} - T_{water}\right)}$$

Heater Input Power (Q=P=IV)

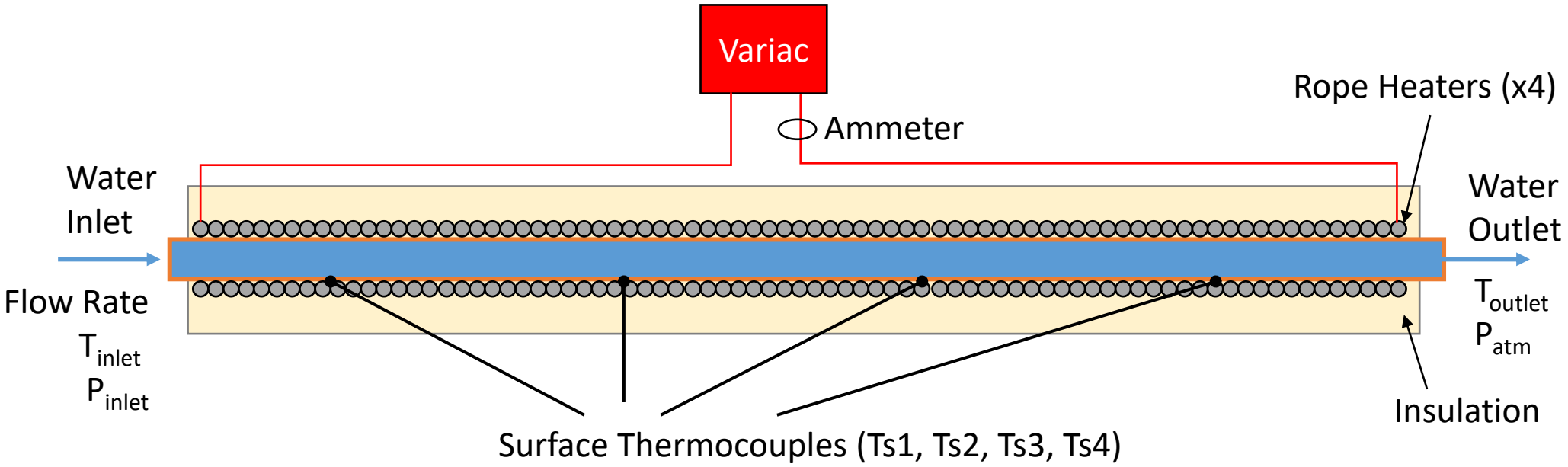
Inner Tube Surface Area

Average Tube Surface Temperature

Average Water Temperature

System energy balance (electrical input power vs. energy gained by water) within 5% for most cases

Experimental Apparatus



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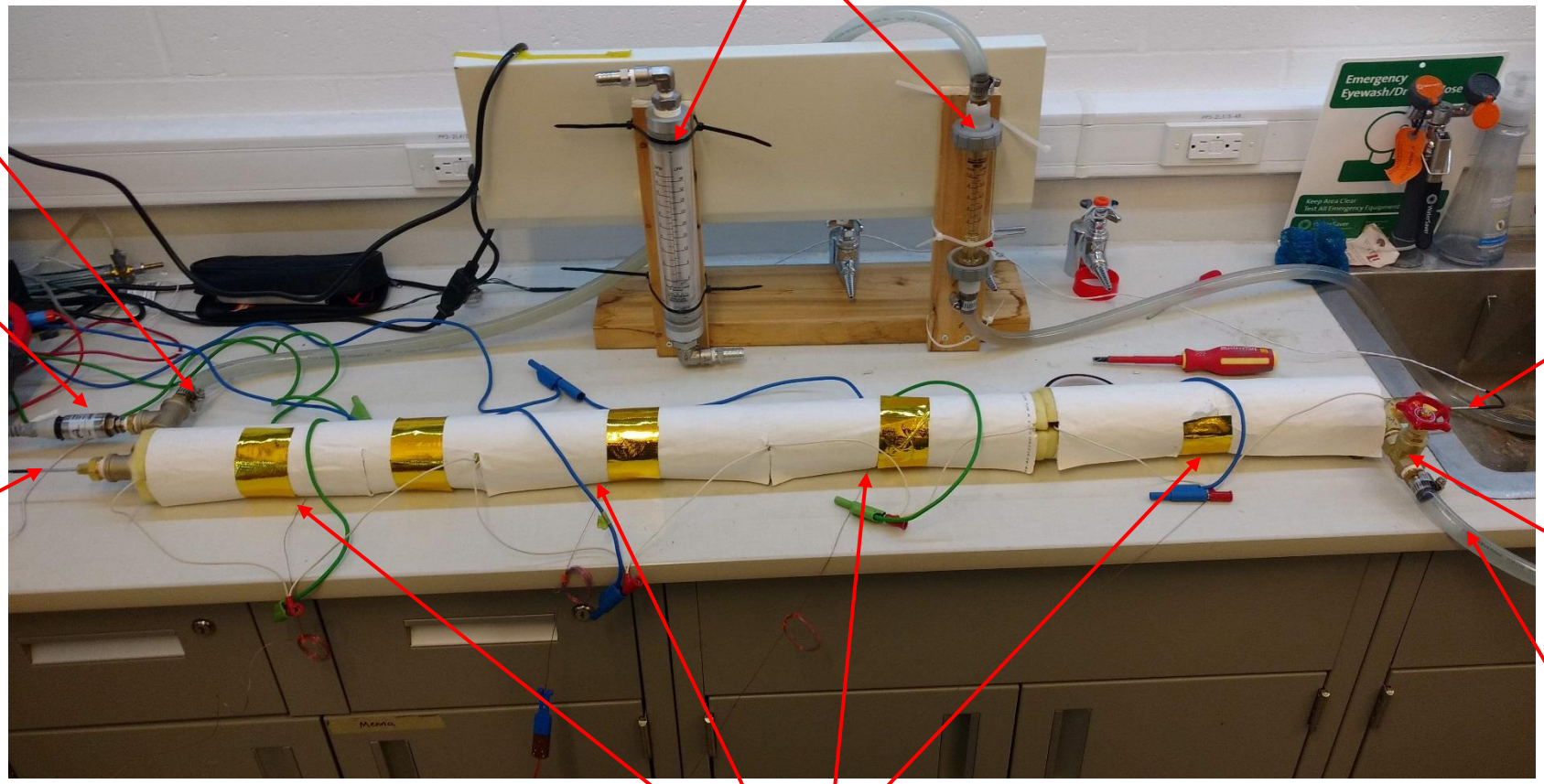
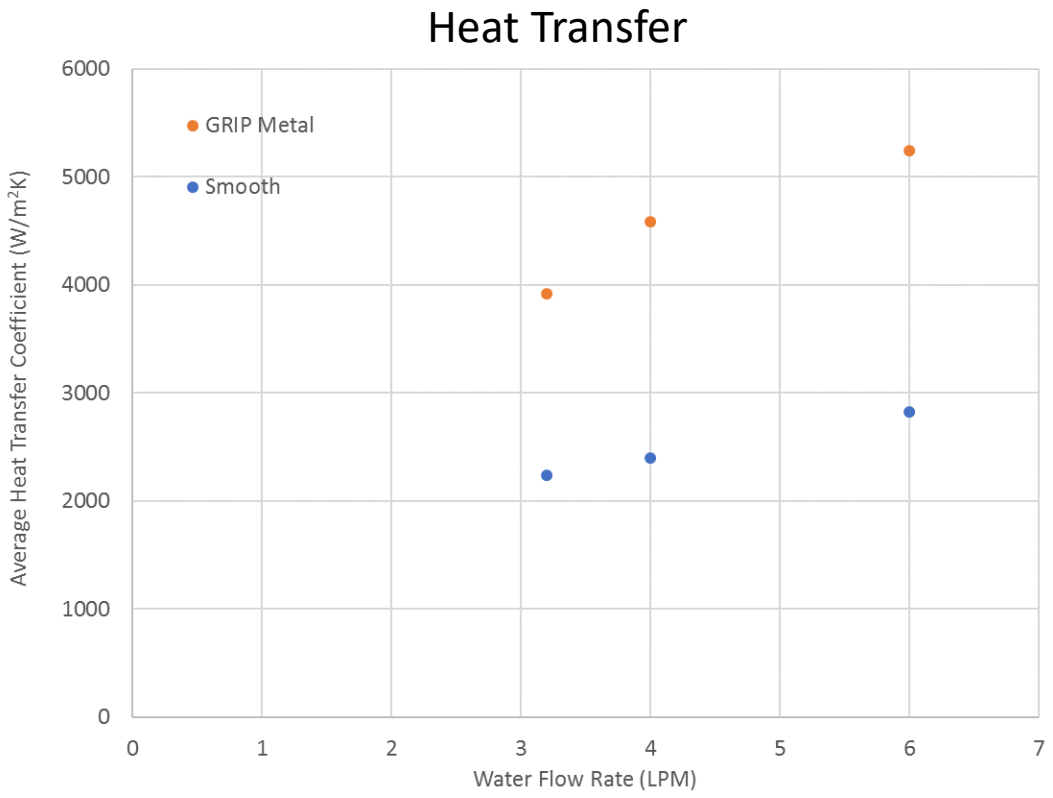
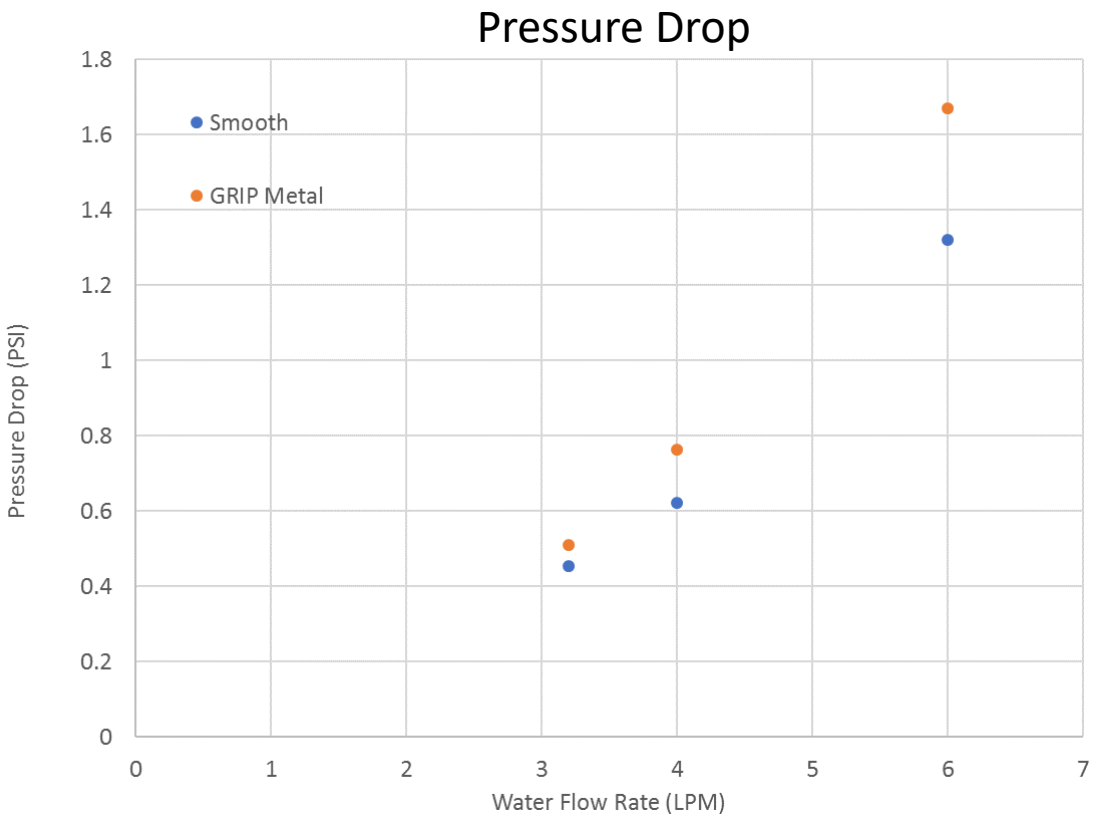
Photograph of Experimental Setup



Results Summary





GRIP Metal features on the inside surface demonstrated **an increase in convective heat transfer coefficient of approximately 75-90%** compared to smooth tube

Corresponding pressure **drop penalty of only 12-25%** increase over smooth tubes for same flow rates

Summary

GRIP Metal enhanced surfaces demonstrate significant increase (75-90%) in convective heat transfer compared to similar smooth tubes for turbulent internal flow.

Practical Implications:

The nearly doubling of heat transfer coefficient observed here means that heat exchangers can be made nearly half the size/weight compared to conventional smooth surfaces

A better understanding of the factors affecting GRIP Metal convection enhancement would offer further heat transfer enhancement and allow for optimization GRIP Metal features for a wide range of heat exchanger applications—see attached proposal