CHAPTER

SEVEN

CONCLUSIONS AND RECOMMENDATIONS

Two TRNSYS models have been presented for a NCHE in a SDHW loop. The simple model, based on Fraser et al.'s work, requires experimental testing on the particular heat exchanger. The simple model can be used for optimizing SDHW system parameters (i.e. pipe lengths and diameters, collector areas, tank volume etc.) excluding the NCHE itself which is represented by the experimental curves. The simple model can also be used as a tool to compare different NCHE systems for which experimental curves exist. A detailed model, based upon cross flow correlations found in the literature, requires geometric specifications of the NCHE being simulated and is applicable to shell and coil and counterflow configurations. By varying heat exchanger geometric parameters (such as the number of helices, diameters of helices, diameter and length of the heat exchanger shell) the detailed model can be used to design an optimum NCHE. Results comparing the detailed model with Fraser et al.'s experiments show adequate agreement. Using the detailed model and the least cost savings economic analysis, simulations were performed to discover the optimal shell and coil NCHE geometry. It was found that considerably reducing the heat exchanger size led to greater system performance. Coil spacing and tube diameter had a lesser impact upon system performance than heat exchanger shell length and number of helices. Thermo Dynamics Inc. manufactures a shell and coil NCHE that contains 4 coils and is 0.635 m. The optimal heat exchanger design contained 2 helices and was 0.45 m long. For a given set of system parameters, a SDHW system containing the optimally designed heat exchanger would save the consumer an extra $110 in initial equipment cost, and $52 over a 10 year period. Heat exchanger designs were subject to variations in system parameters, such as collector area, hot water draw, location and glycol flow rate. Although each set of system parameters suggested a different optimal design, overall, the optimal design found for the initial set of system parameters remained adequate. As different economic assumptions will lead to differing optimal heat exchanger lengths, Chapter 6 can serve as a guide for those who desire to optimize a shell and coil NCHE based upon a prevailing set of economic assumptions.

7.1 Recommendations for Further Work

Although an optimal heat exchanger design was presented in Chapter 6 for a given set of system and economic parameters, a set of generalized curves would be preferable. The generalized curves would be useful for any set of economic and system parameters. Consequently the design of a shell and coil NCHE would no longer require simulations using the detailed model, but instead simple calculations and referencing of the generalized curves.

As Dr. Allen's work progresses (1994), correlations may soon become available for forced and mixed convection heat transfer for flow over vertically oriented enclosed tubes. If and when the correlations become available, it would be advantageous to replace the crossflow correlation with Allen's work.

To date, the detailed model can simulate only the geometry of a shell and coil heat exchanger and a counterflow heat exchanger. It would be useful to extend the simple model to other NCHE geometries, such as a shell and tube heat exchanger with one shell pass and two tube passes.