2.1. Heat Exchangers with Low- and Medium-Finned Trufin

2.1.1 Areas of Application

In Chapter 1, we found that it is usually advantageous to use Trufin Tubes when one of the film heat transfer coefficients is significantly smaller than the other. The lower coefficient tends to dominate or control the magnitude of U, the overall heat transfer coefficient, resulting in a large required heat transfer area and a correspondingly large heat exchanger. We also showed that one can reduce the total length of tubing required and therefore the size of the heat exchanger if finned surface is used in contact with the fluid having the low film heat transfer coefficient.

An approximately optimum design can be obtained under these conditions if the resistances of the two sensible heat transfer processes are approximately equal. This requirement may be stated as

$$\frac{1}{h_i A_i} \approx \frac{1}{h_o A_o}$$

or

$$\frac{A_o}{A_i} \approx \frac{h_i}{h_o}$$

A large number of applications result in values of (h_i / h_o) ranging from 2 to 10, and it is under these conditions that types S/T and W/H Trufin are most applicable, for these tubes have (A_o / A_i) values ranging from just under 3 up to over 6.

This section is devoted to applications where single-phase heat transfer is taking place on the finned surface of the tubes. Typical applications include (but are not limited to) the following:

1. *Cooling of liquids and gaseous product with cooling water.* It is frequently necessary to cool gas or liquid products for storage, using cooling tower or naturally available water. Unless the product is very corrosive, the water will usually be in the tubes. The water coefficient will usually be about 1000 $Btu/hr\ ft^2 °F$, whereas a typical shell-side coefficient will be from 50 for a moderate pressure gas to 300 to 350 for a non-aqueous, low-viscosity liquid. The use of high-finned tube (Type H/F) might be considered for the moderate pressure gas, but construction requirements will usually indicate a shell and tube exchanger with medium-finned type W/H or type S/T Trufin. For the liquids, one of the low-finned type S/T Trufin tubes is usually indicated.

2. *Cooling of compressed gases* (either between the stages or when the compression is complete.) These gas coefficients can vary from 25 to 100; the values are lower than in the previous case because pressure drops are often limited to low velocities through the cooler. Again, medium-finned type S/T or W/H Trufin is probably indicated because of its more favorable area ratios, but low-finned tubing is also often used.

3. *Feed-effluent exchangers and similar arrangements for heat recovery.* There is increasingly a need to recover heat by using a hot effluent stream from a reactor or a distillation column to heat an incoming stream. One of these streams usually has intrinsically a higher heat transfer coefficient (for example, a hot liquid effluent stream) than the other, and exchanger design advantages often result if Trufin is used.

The above are only typical applications for S/T and W/H Trufin. As a general statement, Trufin should be used wherever the resulting exchanger is less expensive or more operationally convenient than the plain tube exchanger required for the same service. Often, only a comparison of the final designs of both the finned and the plain tube exchangers will reveal the advantages of the Trufin tube design.

2.1.2. Description of Low- and Medium-Finned Trufin

1. *Type SIT Trufin® Low-Finned Tube.* An example of Type S/T Trufin tube is shown in Fig. 2. 1. The tube shown has 19 fins per in., but similar tubes are produced with 16, 26, 32, and 40 fins per in. The fin height for these tubes is approximately 1/16 inch, and these are the tubes commonly referred to as low finned tubes. The 40-fin product is also supplied with a .035 in. fin height. The 32-fin product has a fin height of .032 and is generally supplied in titanium.

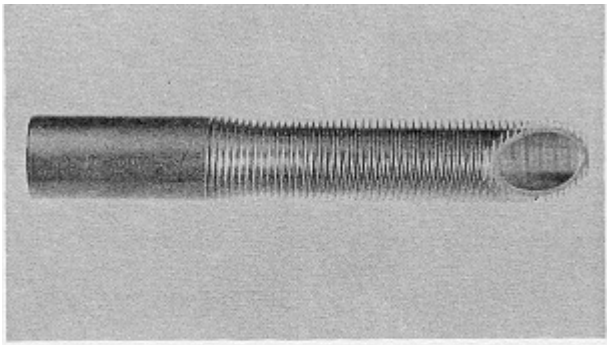

Fig. 2.1 Wolverine Type S/T Trufin® Low-Finned Tube With 19 Fins per In.

2. *Type SIT Trufin® Medium-Finn Tube.* S.T Trufin medium-finned tube is characterized by having 11 fins per in. and fins 1/8 in. high, resulting in outside to inside surface area ratios of about 5. A typical tube is shown in Fig. 2.2.

   These tubes are supplied either with belled ends suitable for rolling into tube sheets or plain ends up to 3 in. in length.

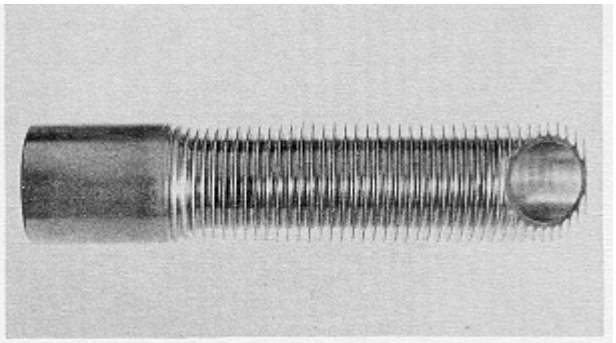

Fig. 2.2 Wolverine Type S/T Trufin® Medium-Finned Tube With 11 Fins per In.

3. *Type S/T Turbo-Chil® Finned Tube.* Type S/T Turbo-Chil finned tube is illustrated in Fig. 2.3. This tube configuration combines the 19, 26, or 40 fins per in. external surface enhancement of conventional S/T Trufin with the enhancement of the inside heat transfer coefficient afforded by the spiral ridges. The turbulence level of the fluid in the tube is increased by the spiral ridges.

   Because Turbo-Chil enhances both the inside and outside heat transfer, it is mainly useful in applications where the heat transfer coefficients on either side of a plain tube would be comparable in magnitude. Turbo-Chil then allows a sharply increased heat transfer rate per unit length of tube and can considerably reduce the volume of heat exchanger required for a particular service.

   Special correlations are required for the in-tube heat transfer and pressure drop for Turbo-Chil.

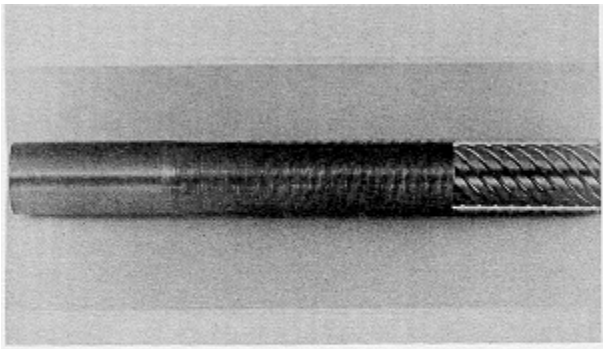

Fig. 2.3 Wolverine Type S/T Turbo-Chil® Finned Tube. Note the 10-start internal ridge.