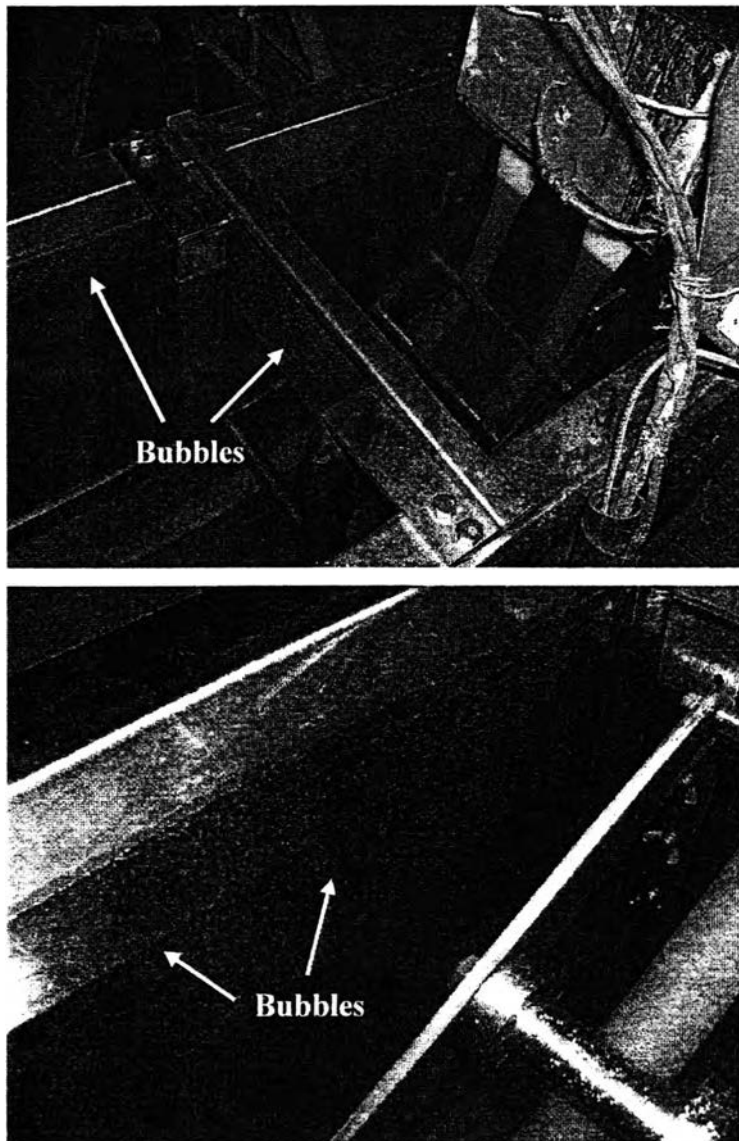


## CHAPTER IV

### SOLUTION AND IMPLEMENTATION

#### 4.1 Recommended Corrective Actions

The results from the experiment concluded that bubbles in chilled water of quenching bath influenced breakage times of PP bands of the study line. Figure 4.1 shows bubbles in chilled water of quenching bath. Bubbles stay everywhere in chilled water of quenching bath which made from stainless steel.

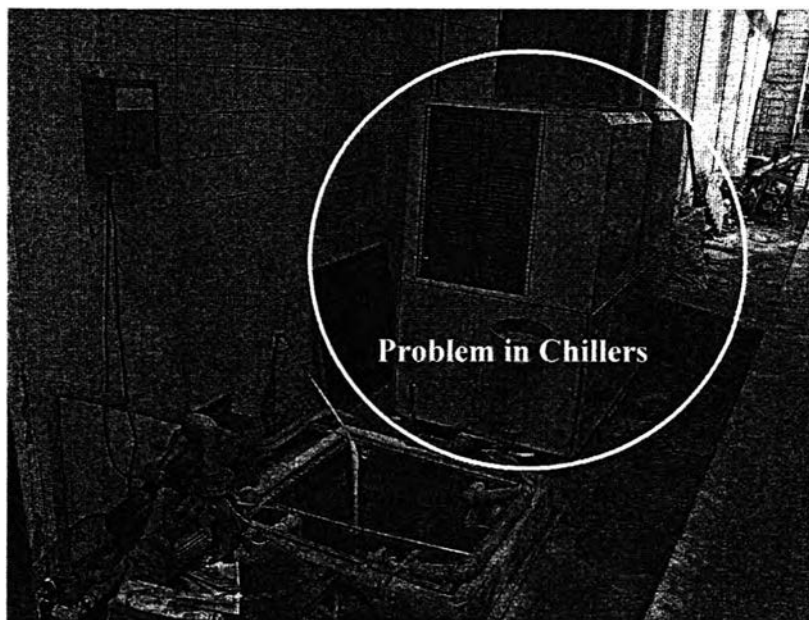


**Figure 4.1: Bubbles in Chilled Water of Quenching Bath**



#### 4.1.1 Root of Cause of Failure: Air Bubbles

After checking chilled water flow system of the study line, it was found that there are no leakages in the system such as in water pipes and in water baths of quenching and cooling process. It was speculated that bubbles in chilled water of quenching bath came from chillers itself (as shown in figure 4.2) which supplies chilled water directly to PP-band lines including the study line.

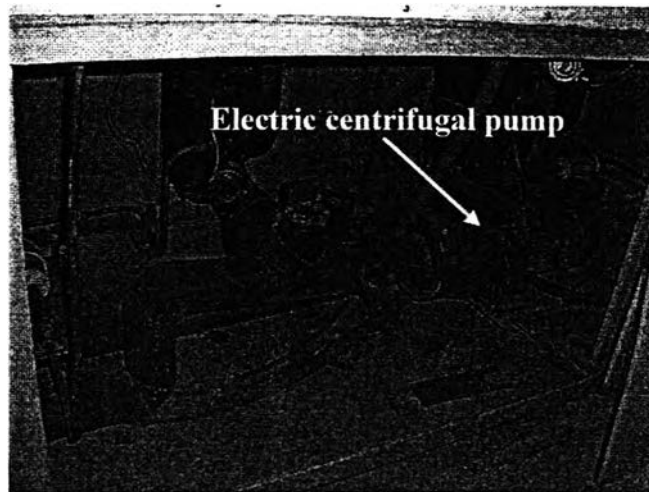


**Figure 4.2: Problem in Chillers Supplying Chilled Water to PP-band Lines**

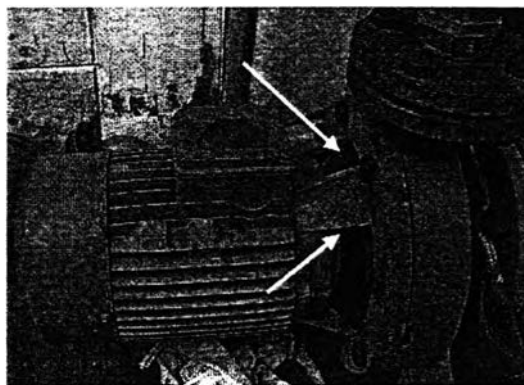
#### 4.1.2 Elimination of Root of Failure Cause

The primary study for cause of bubbles in chilled water was directed at chillers. Therefore, maintenance team was formed to find the causes of bubbles in chillers by checking all possible causes. The maintenance team found that electric centrifugal pump or water pump (as figure 4.3) in the chillers was leaked between O-ring seal of motor shaft in electric centrifugal pump and pump fan, because erodent seal which is caused outside air combined with chilled water to the chillers system. Figure 4.4 and 4.5 show air intake point and O-ring seal whereas figure 4.6 shows side view of electric centrifugal

pump, O-ring seal position and air intake point. Figure 4.7 shows point of leakage with water flow system which electric centrifugal pump sucked water from water tank to plate heat exchangers for chilled water before go to each PP-band lines.



**Figure 4.3: Electric Centrifugal Pump in Chillers**



**Figure 4.4: Air Intake Point**



**Figure 4.5: O-ring Seal Problem of Electric Centrifugal Pump**

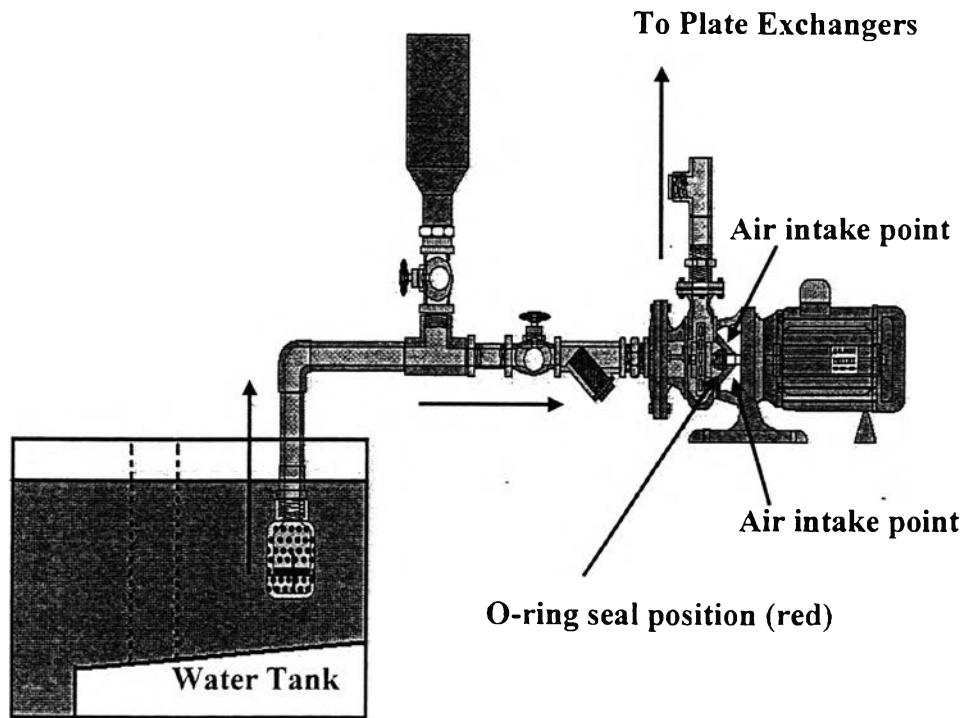


Figure 4.6: Side View of Electric Centrifugal Pump in Chillers

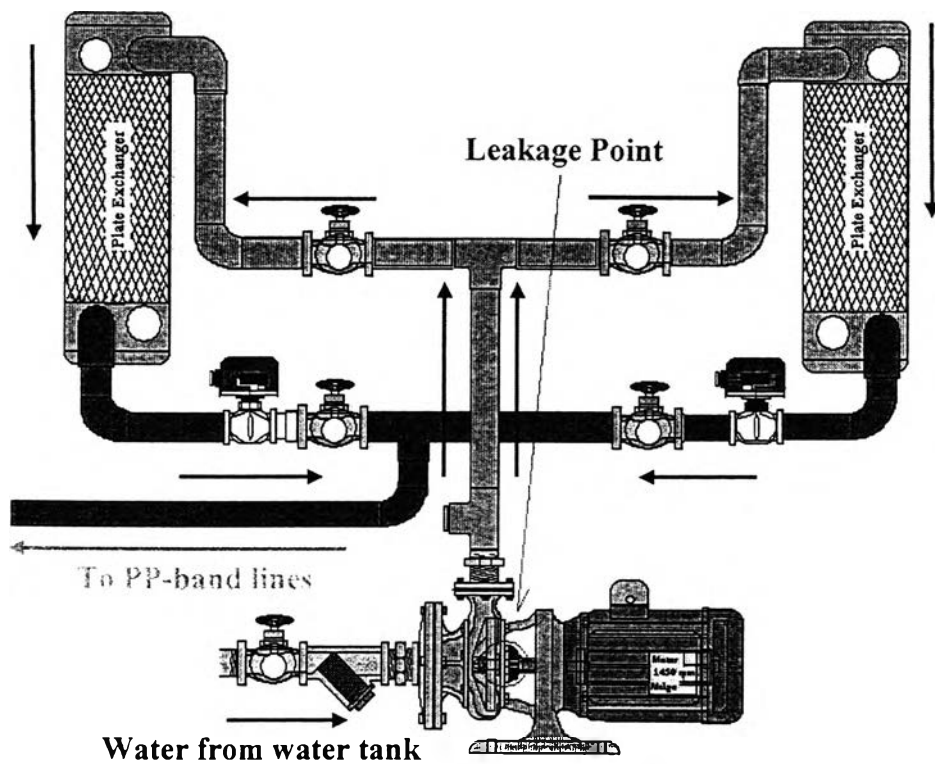
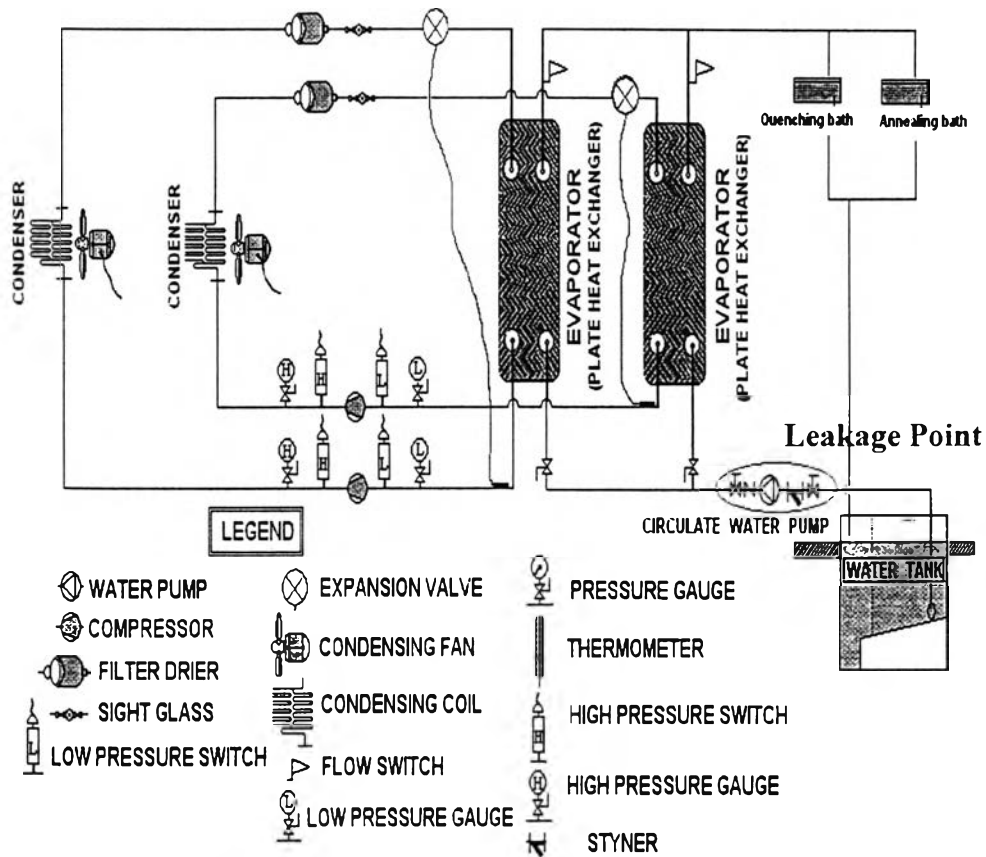


Figure 4.7: Flow of Water in Chillers and Leakage Point in Electric Centrifugal Pump

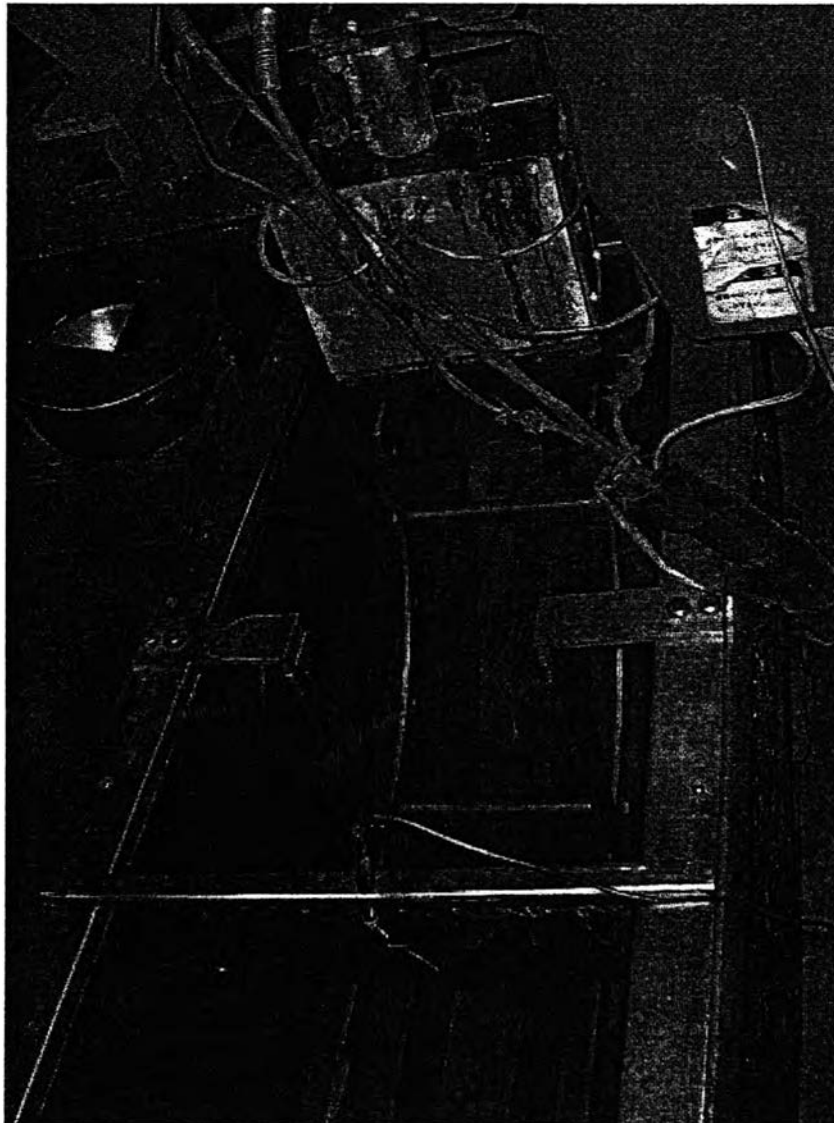


**Figure 4.8: Circuit of Chillers**

Figure 4.8 depicts circuit of chillers and flow of water starting from water tank, passing through circulate water pump (leakage point) and going to evaporators (plate heat exchangers) for chilled water supports quenching and annealing baths in PP-band lines.

## 4.2 Post-Implementation Review

After changing of O-ring seal in electric centrifugal pump, it was found that there are no bubbles in chilled water of the chillers and also no bubbles in chilled water of quenching and annealing baths of PP-band lines including the study line. Figure 4.9 shows chilled water in quenching bath with no bubbles. Breakage failure dramatically reduced because of no effect from bubbles in chilled water to destroy surface of PP bands before stretching process in stretching oven.



**Figure 4.9: No Bubbles in Chilled Water of Quenching Bath**