CHAPTER I
INTRODUCTION

The research activities of the UNB Nuclear centre are on the corrosion of water-based cooling systems and the fouling of heat exchange surfaces. One area that links corrosion and fouling is the sculpting of surfaces that undergo flow-accelerated corrosion (FAC). The sculpting is called scalloping, and the scallop phenomenon is related to the rate of dissolution of the surface (or the corrosion) and to the fluid dynamics.

As steels corrode in water-cooling systems by the phenomenon of FAC, the surfaces normally develop a characteristic pattern that is described as "orange peel" or "scalloping". The pattern has features in common with those developed on some other dissolving surfaces, including geological systems such as limestone deposits in flowing groundwater. The scalloping phenomenon has been observed in many different fields like geomorphology and geology, civil, mechanical and especially chemical engineering. The scalloping found on primary outlet feeder pipes in CANDU reactors is shown in figure 1.1. It seems that the formation and the evolution of scallops in outlet feeder pipes made of carbon steel are major factors in the thinning rate of the pipes, which has been proceeding much faster than expected.

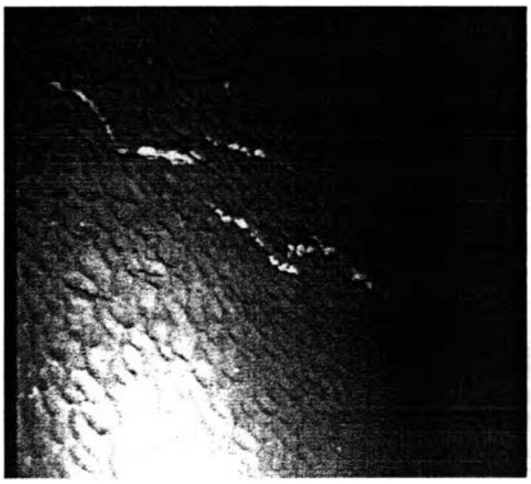

Figure 1.1 Scallops found on outlet feeder pipe k16 (Lister, 2004)

Little progress has been made in understanding the scalloping phenomenon and few experimental data are available. The effects of scalloping on the system variables remain unclear. Moreover, the relation between features of the scalloped surface and other corrosion parameters is not well established.

It is believed that the development of scallops in FAC is linked to the corrosion process and depends on factors such as dissolution rate, the mass transfer coefficient, hydrodynamics, roughness, local turbulence, etc. There have been experiments at UNB to understand scalloping. Villien *et al.* (2005) studied the development of scallops in a pipe made of plaster of Paris in a recirculating water loop. Therefore, further work on dissolving plaster surfaces varying other parameters is discussed here.

The purpose of this work is to investigate in a systematic manner how the dissolution of a pipe coated with plaster leads to scalloping and how the shape and dimensions of the scallops are related to dissolution rate and flow characteristics. Different dissolution rates will be achieved by altering the water chemistry and the temperature, and different flow characteristics by changing flow velocity, which also changes the Reynolds number. A digital camera was used to characterise scallop morphology. Atomic Absorption Spectrophotometry (AAS) was used to measure the calcium concentration in the solution which can be used to calculate the dissolution rate.