CHAPTER VI
CONCLUSIONS AND RECOMMENDATIONS

Modeling of capillary rise of water in an annulus consisted of two parts, a surface shape and a height of the rising water. The meniscus shape was obtained analytically and numerically based on the curvature of the surface. First, an equation of the surface curvature was developed and solved analytically. The analytical solution was then used to study the characteristic of the meniscus.

The contact angle was found to be dependent on a surface type. The surface of ground calcite, ground glass, dolomite and ground dolomite are highly hydrophilic. In contrast, the calcite and glass slide surfaces are less hydrophilic. Water and mercury were also used to investigate the menisci between different liquids.

Second, the fourth-order Runge Kutta and Euler's methods were applied to numerically solve for the meniscus shape. Unlike the analytical solution, the numerical solutions can be used to describe the meniscus shape very well. The reason is the meniscus heights resulted from the experiment at the inner tube wall and outer tube wall were not identical due to the change of the annular gap width along the angular direction. Consequently, the analytical solution cannot satisfy the experimental data as a result of the identical heights at the inner and the outer tube walls assumption. In contrast, the numerical models agreed well with the experimental data because the assumption of the identical height was not imposed.

The other part of the model is the height of the rising water from the flat water surface to the bottom of the meniscus. The experimental and the modeling results were not in good agreement. The discrepancy was probably due to a large gap width of the annulus because an accuracy in the measurement of the rising liquid height is inversely proportional to the gap width.

The experiment results have shown that the annular tube was made non-axisymmtrically. That is the gap width is varied along the angular direction. It is crucial to make the annular gap width constant in both angular and axial directions. Furthermore, the heights of the menisci at inner and outer walls should be identical but, from the results, they were not. That may be caused by the unequal of the gap width along the axial direction. Since a height of capillary rise strongly relies on the navigable area of the rising liquid, a gap width must be made as small as possible.