INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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SHORT ABSTRACT

Subsurface temperature is generally affected by the natural trend of steady upward flux of heat from the interior of Earth. Temporal fluctuations of surface air temperature and sustained effect of it over ground surface produce temperature anomaly up to a *certain* depth of subsurface. Subsurface temperature can affect the soil-water flow through the temperature derivative of *capillary pressure* (or, *temperature coefficient*), thereby, signifying the effects of existent temperature gradient in the subsurface. Capillary pressure is calculated as the product of the surface tension of the liquid and mean curvature of the air-liquid interface or meniscus in unsaturated soil (otherwise known as Young-Laplace (Y-L) equation). Researchers are still unable to give a coherent theory encompassing the effects of contact angle, moisture content and air phase along with the temperature coefficient and as well they have questioned the applicability of Y-L equation. It has been shown that the universally assumed spherical meniscus shape failed to provide proper answers on the capillary pressures. A new form named as *phenomenological meniscus equation* (PME) has been presented. This meniscus form is incorporated in the Y-L equation to calculate capillary pressure. Assumption of spherical meniscus imposed upon Y-L equation, i.e. the usual form of Y-L equation fails to incorporate real contact angle (ACA) and fails in more general term. Inclusion of gravity effects in the formation of meniscus as PME gives the effect of ACA with temperature and liquid content (or, 1 - air content) as found in experiments. Presence or absence of air phase over meniscus changes the trend. Presence depicts the increasing trend and absence shows the decreasing trend of the temperature coefficient of ACA for hydrophilic soil and vice versa for hydrophobic soil. This shows that assumption of uniformity of air in porous domain is not the case and the effects of air or gaseous phase should be considered. The PME encompasses the whole effect of pore radius, contact angle and surface tension of liquid. Spherical shape may not be a good approximation universally, though it serves well for most cases. It is an assumption, *not* a fact. Emphasizing over last point, it is very important to note that curvature is a central factor in estimating the temperature coefficient of capillary pressure. A correction factor is recommended to the usual form of the Y-L equation to incorporate the effects of air or gaseous phase.