ABSTRACT. The effects of intra-particle radiative heat transfer on the temperature profiles of a porous particle undergoing heating and cooling processes are investigated. Two particle compositions with differing porosity and optical properties are considered. Two processes are considered for each particle composition: heating under direct concentrated solar irradiation and passive cooling. A novel formulation of the boundary condition for a directly irradiated participating medium surrounded by a non-participating medium is presented for the $P_1$ approximation. Transient temperature profiles from simulations utilizing the $P_1$ approximation and the presented boundary condition are compared to profiles from simulations utilizing the Rosseland diffusion approximation for all cases considered.