Drying and tempering models for paddy drying by a fluidised bed technique have been developed to describe the moisture movement inside a single paddy kernel. The grain shape was considered as a finite cylinder. The internal diffusion is an important contribution to control the drying rate of paddy. The dependence of effective diffusion coefficient on drying temperature can be adequately explained based on Arrhenius form. The parameters of this equation were evaluated in the range of temperatures between 110 °C and 170 °C by using the regression analysis with 189 experimental drying data. As compared with no tempering, the faster drying rate can be obtained by tempering treatment between drying stages. The effect of degrees of tempering on determining the moisture reduction in the second stage has also been explored. According to the simulation results, a prediction equation of the required tempering time for the tempering index of 0.95 has been established in which the drying air temperature, initial moisture content and drying time are taken into account. The tempering time for 35 min is recommended for the continuous fluidised bed dryers being operated in rice mills.