Gas hydrates are inclusion compounds that are formed when water molecules hydrogen bond around a guest molecule, usually a light hydrocarbon. Hydrates have important implications in the energy industry; their prevention in flow assurance is integral as they can block pipelines and disrupt production. Hydrate properties can be difficult to study due to hydrate formation conditions typically being at high pressures and low temperatures. Cyclopentane hydrates form at atmospheric pressure and are stable at temperatures from 0 to 7.7 °C. Cyclopentane forms a structure II hydrate, which is the same structure that is commonly found in oil/gas pipelines. A micromechanical force measurement apparatus that directly measures the interparticle forces between hydrates was utilized in this study. When hydrates form in a pipeline, it is hypothesized that they form as a thin film on the surface of emulsified water droplets, and the film thickens over time to form rigid particles. Here we report the relative puncture strength and the thickness of the hydrate shell as functions of the system properties. It was discovered that hydrate shell puncture strength increases with both annealing time and subcooling below the equilibrium temperature. These data allow better insight into the kinetics of hydrate growth, as well as information on the mass transfer limitations through a hydrate film.