Thiol-functionalized silica that has been used to remove heavy metal from an aqueous solution and support metallic nanoparticles is usually synthesized by reflux in an organic solvent containing 3-mercaptopropyltrimethoxysilane (MPTMS). In this paper, we report a gentle method for grafting thiol-functional groups onto silica gel by an aging process that does not require mixing and refluxing in an organic solvent. Silica gel was synthesized by a sol–gel method from H_2SO_4 (40%) and sodium silicate, which was crushed into beads with sizes ranging from 180 to 450 μm. Silica beads (50 g) were mixed with 75 mL of a functionalization solution consisting of MPTMS, H_2O, and C_2H_5OH and aged at 50 °C for 36 h in a box dryer. The success of the functionalization process was confirmed by FT-IR, BET, SEM and elemental analyses. The functionalization solution was percolated into pores and thiol functional groups were grafted onto the surface and pore walls of the silica beads. The ability of these functionalized silica beads to adsorb silver ions was determined by the Langmuir isotherm equation with a maximum adsorption of 75.8 mg/g. Silver nanoparticles with sizes ranging from 2 to 6 nm formed by chemical reduction were located inside the pores and on the surfaces.