The present study reports the antibacterial disinfection properties of a series of silver nanoparticle (AgNPs) immobilized membranes. Initially, polyethersulfone (PES) was functionalized through the introduction of amino groups to form animated polyethersulfone (NH2-PES, APES). AgNPs were then coordinately immobilized on the surface of the APES composite membrane to form AgNPs-APES. The properties of the obtained membrane were examined by FT-IR, XPS, XRD, TGA, ICP-OES and SEM-EDAX analyses. These structural characterizations revealed that AgNPs ranging from 5 to 40 nm were immobilized on the surface of the polymer membrane. Antibacterial tests of the samples showed that the AgNPs-APES exhibited higher activity than the AgNPs-PES un-functionalized membrane. Generally, the AgNPs-APES 1 cm × 3 cm strip revealed a four times longer life than the un-functionalized AgNPs polymer membranes. The evaluation of the Ag+ leaching properties of the obtained samples indicated that approximately 30% of the AgNPs could be retained, even after 12 days of operation. Further analysis indicated that silver ion release can be sustained for approximately 25 days. The present study provides a systematic and novel approach to synthesize water treatment membranes with controlled and improved silver (Ag+) release to enhance the lifetime of the membranes.