

PENGARUH PENAMBAHAN NANOPARTIKEL CuO TERHADAP SIFAT MEKANIK DAN ANTIBAKTERI MINERAL TRIOKSIDA AGREGAT PUTIH

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INTISARI

Sintesis nanopartikel CuO (CuONP) untuk meningkatkan sifat antibakteri pada mineral trioksida agregat putih (WMTA) telah berhasil dilakukan. Tujuan dari penelitian ini adalah mempelajari pengaruh penambahan CuONP pada WMTA terhadap sifat mekanik dan sifat antibakterinya terhadap *Staphylococcus aureus* dan *Pseudomonas aeruginosa*. Nanopartikel CuO disintesis dengan mencampurkan 25 mL $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ 0,5 M dan Na_2CO_3 0,5 M pada variasi volume (15, 25, dan 42 mL) melalui metode dekomposisi termal dengan bantuan sonokimia. Campuran disonifikasi pada temperatur 60 °C selama 2 jam dan dilanjutkan dengan kalsinasi pada temperatur 600 °C selama 4 jam. Material WMTA/CuO dibuat dengan mencampurkan WMTA dan CuONP pada variasi persentase massa (1, 2, dan 3%). Nanopartikel CuO, material WMTA, dan WMTA/CuO dikarakterisasi dengan *Fourier Transform Infrared* (FT-IR), *X-Ray Diffractometer* (XRD), dan *Scanning Electron Microscopy-Energy Dispersive X-ray* (SEM-EDX).

Hasil karakterisasi FTIR dan XRD menunjukkan bahwa CuONP berhasil disintesis, ditandai adanya puncak-puncak karakteristik CuO dengan ukuran kristal pada masing-masing variasi, yaitu 33,99; 20,52; dan 21,94 nm. Penambahan CuONP pada WMTA mampu meningkatkan sifat mekaniknya, yaitu kuat tekan tertinggi $12,03 \pm 0,44$ MPa ditunjukkan pada WMTA/CuO-2. Sementara itu, penambahan CuONP 1-3% pada WMTA memberikan perubahan secara signifikan terhadap antibakteri *S. aureus* dengan nilai zona hambat sebesar $6,69 \pm 0,67$ mm untuk WMTA/CuO-2 dan $6,77 \pm 0,31$ mm untuk WMTA/CuO-3. Namun, daya antibakteri terhadap bakteri *P. aeruginosa* kurang signifikan dengan nilai zona hambat hanya meningkat dari $5,50 \pm 0,00$ mm menjadi $7,04 \pm 0,39$ mm pada WMTA/CuO-3.

Kata kunci: antibakteri, nanopartikel CuO, sifat mekanik, WMTA.

***THE EFFECT OF CuO NANOPARTICLES ADDITION ON
MECHANICAL AND ANTIBACTERIAL PROPERTIES
OF WHITE MINERAL TRIOXIDE AGGREGATE***

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ABSTRACT

Synthesis of CuO nanoparticles (CuONP) to improve the antibacterial properties of white mineral trioxide aggregate (WMTA) has been successfully carried out. The goal of this research was to study the effect of the addition of CuONP to WMTA on their mechanical and antibacterial properties against *Staphylococcus aureus* and *Pseudomonas aeruginosa*. The CuO nanoparticles were synthesized mixing by 25 mL of CuSO₄·5H₂O 0.5 M and Na₂CO₃ 0.5 M at volume variations (15, 25, and 42 mL) through a sonochemical-assisted thermal decomposition method. The mixture was sonicated at 60 °C for 2 h and continued by calcination at 600 °C for 4 h. The material of WMTA/CuO was made mixing by WMTA and CuO nanoparticles at variations in weight percentage (1, 2, and 3%). The CuO nanoparticles, WMTA, and WMTA/CuO were characterized with Fourier Transform Infrared Spectrometer (FT-IR), X-Ray Diffractometer (XRD), and Scanning Electron Microscopy-Energy Dispersive X-ray (SEM-EDX).

The results of the FTIR and XRD characterization showed that CuONP was successfully synthesized, indicated by the characteristic peaks of CuO with crystal size of each variations, which 33.99; 20.52; and 21.94 nm. The addition of CuONP to the WMTA may improve the mechanical properties, that is compressive strength of 12.03±0.44 MPa shown in the WMTA/CuO-2. Meanwhile, the addition of 1-3% CuONP in the WMTA gave a significant change to the antibacterial *S. aureus* with an inhibition zone value of 6.69±0.67 mm for WMTA/CuO-2 and 6.77±0.31 mm for WMTA/CuO-3. However, the antibacterial activity against *P. aeruginosa* was less significant, with the inhibition zone value only increasing from 5.50±0.00 to 7.04±0.39 mm in WMTA/CuO-3.

Keywords: antibacterial, CuO nanoparticles, mechanical properties, WMTA.