

Efek medan magnet pada penurunan kesadahan dan pencegahan pembentukan kerak CaCO_3 = The effect of magnetic field on reducing hardness and preventing CaCO_3 scale formation

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Abstrak

Metode alternatif yang dapat digunakan untuk mengurangi kesadahan dan menekan tendensi terbentuknya deposit kerak adalah Magnetic Water Treatment (MWT). Kritik yang biasa dilontarkan tentang metode ini adalah hasil dari alat MWT pada saat penerapannya banyak yang tidak efektif. Selain itu masih terdapat pro-kontra di kalangan peneliti mengenai efektivitas proses magnetisasi dan kondisi operasinya. Oleh karena itu dibutuhkan penelitian lebih lanjut tentang metode magnetisasi ini sebagai metode alternatif pengolahan air sadah. Penelitian dilakukan untuk menguji pengaruh dari medan magnet terhadap presipitasi CaCO_3 total setelah sirkulasi, tendensi presipitasi setelah magnetisasi dan filtrasi, juga jenis kristal CaCO_3 pada air sadah sintetik (larutan Kalsium Karbonat) sistem dinamis sirkulasi dengan magnet permanen dan EMF (Electromagnetic field). Variabel kondisi operasi meliputi laju alir, lama waktu sirkulasi, jumlah magnet dan konsentrasi sampel pada sistem magnet permanen, sementara untuk EMF dilakukan pengamatan pengaruh induksi dan osilasi medan listrik pada kumparan solenoida saat sirkulasi dan variasi waktu sirkulasi. Pengukuran konsentrasi CaCO_3 pada larutan Kalsium Karbonat dilakukan dengan metode titrasi kompleksometri EDTA setelah sirkulasi dan saat presipitasi selama 3 jam setelah filtrasi. Uji XRD dan SEM dilakukan untuk mengetahui jenis kristal yang terdeposit di permukaan pelat kaca. Hasil penelitian menunjukkan bahwa magnetisasi dapat meningkatkan persen presipitasi CaCO_3 total setelah sirkulasi dan mengurangi tendensi presipitasi CaCO_3 setelah filtrasi. Gaya Lorentz dan magnetohidrodinamika pada sistem magnet permanen diduga berperan meningkatkan nukleasi dan presipitasi CaCO_3 saat sirkulasi, sementara efek hidrasi ion mengurangi tendensi presipitasi setelah magnetisasi dan filtrasi. Pada sistem EMF, induksi dan osilasi medan listrik pada kumparan solenoida diduga meningkatkan proses tumbukan ion dalam larutan sehingga memicu presipitasi dan mengurangi kemampuan sampel olahan untuk terpresipitasi setelah sirkulasi. Jenis deposit kristal CaCO_3 yang terbentuk di pelat kaca adalah kalsit, sementara hasil pengujian SEM menunjukkan terbentuk 3 jenis kristal CaCO_3 setelah sirkulasi maupun setelah presipitasi selama 3 jam.

Alternative method that can be used to reduce hardness and suppress tendency of deposits scale formation is Magnetic Water Treatment (MWT). Critics that are usually reported about this method are the low effectiveness when using MWT devices. There are also a lot of contradiction among researcher about the effectiveness of magnetization process and process condition. Therefore, an advanced research about magnetization method is needed as an alternative method on treating hard water. This research was conducted to investigate magnetic field effect on total CaCO_3 precipitation after circulation, tendency of precipitation after magnetization and filtration, and also CaCO_3 structure within synthetic hard water solution (Calcium Carbonate solution) under dynamic circulation by using permanent magnet or EMF (Electromagnet field) system. process variable using permanent magnet include flow rate, circulation time, numbers of permanent magnet and hardness solution, meanwhile for EMF system, the observation was done to investigate the induction of electric current effect through wrapped solenoid during circulation and also

variation of circulation time. Measurement concentration of CaCO₃ within Calcium Carbonate solution was done with EDTA complexometry titration after circulation and during 3 hours of precipitation time after filtration. XRD and SEM analysis were done to observe structure of formed deposits on the surface of coupon glass. The results show that magnetization can increase total CaCO₃ precipitation percentage after circulation and then reduce CaCO₃ precipitation tendency during precipitation time after filtration process. Lorentz force and Magnetohydrodynamic effect are hypothesized to take role on increasing nucleation and precipitation of CaCO₃ during circulation on permanent magnet system, meanwhile hydration ions effect reduce precipitation tendency after magnetization and filtration. When using EMF system, induction and oscillation of electric field on solenoid wrapped is hypothesized to increase ion collision process within solution so that it promotes precipitation and reduce the ability of treated sample to precipitate after circulation. Deposits crystal that formed on surface of coupon glass using XRD analysis are calcite, on the other hand, SEM analysis results show 3 kind of CaCO₃ crystal structure both after circulation and during 3 hours of precipitation time.