INTISARI

Total potensi energi panas bumi di Indonesia diperkirakan 29.544 MW. Namun, sebagian besar dari potensi ini belum digunakan. Saat ini, Indonesia hanya menggunakan 8,9 % dari sumber daya tersebut. Pemanfaatan panas bumi di Indonesia belum dilakukan secara maksimal karena beberapa kendala salah satunya dikarenakan permasalahan teknis pembentukan *silica scaling.* Silika yang terkandung di dalam *brine* ini umumnya diendapkan dalam kanal atau bak pengendap yang cukup luas sebelum *brine* direinjeksi ke perut bumi. Agar investasi pengembangan panas bumi dapat ditekan, proses presipitasi silika di dalam kanal/bak pengendap perlu dipercepat. Percepatan proses presipitasi dapat dilakukan dengan menambahkan *seeds* ke dalam *geothermal brine*. Tujuan penelitian ini adalah menentukan kondisi dan dosis optimum proses presipitasi silika, menentukan kinetika presipitasi silika, dan menentukan nilai parameter persamaan kinetika presipitasi yang telah disusun sebagai fungsi variabel yang mempengaruhi proses presipitasi silika pada *geothermal brine*.

Pada penelitian ini, *brine* diambil dari sumur panas bumi di Pembangkit Listrik Tenaga Panas Bumi (PLTP) PT Geo Dipa Energi, Dieng, Jawa Tengah, Indonesia. *Nano-silica seeds* ditambahkan ke dalam *brine* pada pH, suhu, dan kecepatan pengadukan yang telah disesuaikan. Selama presipitasi 1 ml sampel diambil untuk diukur konsentrasinya dengan menggunakan *Inductively Coupled Plasma* (ICP).

Berdasarkan percobaan yang telah dilakukan didapatkan hasil bahwa konsentrasi silika dalam *brine* dapat dikurangi dengan penambahan *nano-silica seeds*. Proses presipitasi silika dipengaruhi oleh transfer massa dari badan cairan ke permukaan padatan. Semakin tinggi suhu maka semakin tinggi konsentrasi monomer silika. Semakin tinggi pH maka semakin rendah konsentrasi monomer silika. Semakin tinggi kecepatan pengadukan maka koefisien transfer massa menjadi semakin tinggi. Proses presipitasi optimal pada suhu 60ºC, pH 7, kecepatan pengadukan 800 rpm dengan penambahan *seeds* sebanyak 0,3 gram dalam 200 ml *brine*. Pada kondisi ini diperoleh nilai SSI, koefisien transfer massa, dan diameter akhir partikel secara berturut-turut 0,68; 0,0018 cm/s; dan 399 nm. Tetapan laju transfer massa dalam bentuk Persamaan bilangan tak berdimensi sebagai berikut.

$$\frac{k_c . d_p}{D} = 0{,}0464 Re^{0{,}7199} Sc^{0{,}4733}$$

Kata kunci: *Geothermal brine*, *Nano-silica seeds*, Metode *seeding*, *Silica scaling*, Kinetika presipitasi

ABSTRACT

The total potential of geothermal energy in Indonesia is estimated at 29,544 MW. However, most of this potential has not been used. Currently, Indonesia uses only 8.9% of these resources. Utilization of the geothermal potential is constrained by several problems, one of which is silica scaling. The silica contained in the brine is generally deposited in canals or settling tanks that are quite extensive before the brine is reinjected into the bowels of the earth. In order to reduce investment in geothermal development, the process of silica precipitation in the canals/settling tanks needs to be accelerated. Accelerating the precipitation process can be done by adding seeds to the geothermal brine. The aims of this study were to determine the optimum conditions and doses for the silica precipitation process, to determine the kinetics of silica precipitation, and to determine the parameter values of the precipitation kinetic equations, which have been constructed as a function of the variables that affect the silica precipitation process in geothermal brine.

In this study, brine was taken from a geothermal well at PT Geo Dipa Energi's Geothermal Power Plant (PLTP), Dieng, Central Java, Indonesia. Nano-silica seeds are added to the brine at an adjusted pH, temperature, and stirring speed. During precipitation, 1 ml of sample is taken to measure its concentration using Inductively Coupled Plasma (ICP).

Based on the experiments that have been carried out, it was found that the concentration of silica in brine can be reduced by adding nano-silica seeds. The process of silica precipitation is affected by mass transfer from the liquid body to the solid surface. The higher the temperature, the higher the concentration of silica monomer. The higher the pH, the lower the concentration of silica monomer. The higher the stirring speed, the higher the mass transfer coefficient. The optimal precipitation process is at 60ºC, pH 7, stirring speed of 800 rpm with the addition of 0.3 grams of seeds in 200 ml of brine. Under these conditions, the SSI, mass transfer coefficient, and final particle diameter were obtained, respectively 0.68; 0.0018 cm/s; and 399 nm. The mass transfer rate constant in the form of the dimensionless number equation is as follows.

$$.\frac{k_c.d_p}{D} = 0{,}0464Re^{0{,}7199}Sc^{0{,}4733}$$

Keywords: *Geothermal brine; Nano-silica seeds, Seeding method; Silica scaling; Precipitation kinetics*