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Permanent magnets for water-scale prevention

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ABSTRACT

Anti-scale magnetic treatment (AMT) is discussed with the emphasis on the construction of magnetic devices and the mechanism of AMT influence on scale formation. Two field cases are reported of mineral-fouling reduction during water heating by using permanent magnets. Instead of hard encrustation on the heated surfaces a powdery deposit was formed because of modified crystal morphology (observed by X-ray powder diffractometry and scanning-electron microscopy). In order to find a proper design for magnets regarding the influencing parameters (a magnetic-field distribution with alternating lines orthogonal to the water-flow and minimal density peaks 0.2 T), cost-effective for actual water-flow capacities, several models with NdFeB magnets were simulated by the finite-element method using the OPERA 15R1 computational program. Two optimized models are presented for moderate capacities: a model with a rectangular gap (a two-row set of rectangular magnets) for capacities from 0.5 m^3/h to 3 m^3/h, and a model with annular gap (annular magnets on a pipe and disk magnets within a cylindrical kernel) for 3.5 m^3/h to 5.5 m^3/h.

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Trajni magneti za preprečevanje vodnega kamna

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POVZETEK

Prispevek obravnava magnetno obdelavo za preprečevanje vodnega kamna; poudarek je na konstrukciji magnetne naprave in mehanizmu vpliva obdelave na tvorbo oblog. Poroča o dveh primerih zmanjšanja oblog med segrevanjem vode z uporabo magnetov: namesto trde obloge na grelni površinah se je tvorila prašnata prevleka kot posledica sprememb v obliki kristalizacije (opaženih z rentgenskim praškovnim difraktometrom in skenirnim elektronskim mikroskopom). Za postavitev ustreznega modela magnetne naprave, rentabilne za realne pretoke vode, so bili – upoštevajoč vplivne parametre (tj. porazdelitev magnetnega polja z izmeničnimi silnicami pravokotnimi na vodni tok in vrhovi gostote magnetnega polja minimalno 0.2 T) – simulirani razni modeli magnetov NdFeB z metodo končnih elementov in z uporabo računalniškega programa OPERA 15R1. V delu sta predstavljena dva optimalna modela: vzporedni niz pravokotnih magnetov za zmerne vrednosti pretokov 0.5 m3/h do 3 m3/h in model s prstanasto režo (niz prstanastih magnetov na cevi in diskastih magnetov znotraj cilindričnega jedra) za večje pretoke, 3.5 do 5.5 m3/h.

PODATKI O ČLANKU

Ključne besede:
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