

SARI

Intrusi air laut sebagai fenomena alam pada akuifer dangkal dilaporkan telah terjadi yang intensitasnya dapat meningkat seiring pembangunan Kawasan Industri Terpadu (KIT) dan Pembangkit Listrik Tenaga Uap (PLTU) pada Kabupaten Batang, berimbas pada pertumbuhan penduduk dan peningkatan aktivitas manusia dalam kaitannya dengan pemenuhan kebutuhan air bersih yang mampu memicu *overpumping* di areal industri maupun pemukiman di sekitarnya. Kajian akan intrusi menjadi penting untuk memahami distribusi spasial intrusi air laut melalui evaluasi hidrokimia air tanah yang dilakukan pada daerah rawan intrusi, seperti pesisir barat Kabupaten Batang (mencakup Kecamatan Batang, Kandeman, Tulis, dan Subah). Pengamatan lapangan akan kondisi geologi – geomorfologi dan hidrogeologi, yang lalu digabungkan dengan data geokimia air tanah yang terdiri atas pH, daya hantar listrik, *total dissolved solids*, dan suhu. Analisis lanjutan yakni *Ion Chromatography* dan titrasi untuk mengetahui konsentrasi ion mayor dan ion minor (bromida) pada sampel air tanah, dan volumetri metode Mohr untuk menentukan kadar klorida dalam *bulk* sampel tanah. Data tersebut dimanfaatkan untuk menentukan besaran geoindikator intrusi air laut yang digunakan pada penelitian yakni peningkatan EC (DHL) dan Cl, rasio Cl/Br, rasio Simpson, rasio Na/Cl, nilai BEX, plot EC vs Cl, SMI, TDS vs *depth*, HFE-D diagram, dan indeks CAI. Kontaminasi nitrat dan pelarutan *soluble salts* juga digunakan sebagai pertimbangan efek intrusi. Pokok dari penelitian ini yakni dihasilkannya kelompok tingkat intrusi air laut berdasarkan jumlah dan distribusi geoindikator terkonfirmasi, serta integrasi keseluruhan data pada model konseptual akuifer.

Hasil penelitian menunjukkan secara geologi – geomorfologi areal penelitian terdiri atas litologi breksi vulkanik dan batupasir tufan sisipan batulanau tufan pada satuan perbukitan vulkanik lereng bawah, serta aluvium yang tersusun atas lempung pasir dan pasir halus yang masing-masing berada pada satuan dataran aluvial dan dataran pantai. Peninjauan hidrogeologi menunjukkan kedalaman air tanah dangkal berkisar 0,1 – 24 mdpt dengan aliran yang relatif berarah selatan – utara. Fasies air tanah yang menyusun daerah penelitian secara berurutan dari daratan ke arah garis pantai yakni Ca, Mg – HCO₃, Na – HCO₃, dan Na – Cl, yang juga diikuti dengan peningkatan EC, TDS, serta konsentrasi ion secara signifikan pada pesisir barat dan timur areal penelitian, dengan faktor utama yang mempengaruhi kimia air berupa *direct ion exchange* pada Na – K dalam akuifer dan Ca – Mg dalam air tanah. Klasifikasi intrusi air laut menunjukkan air tanah normal dengan fasies air Ca – HCO₃ dan Na – HCO₃ mendominasi area penelitian, dan air tanah terintrusi yang umumnya tersebar di area pesisir barat dan timur (dibedakan atas tingkat intrusi ringan, sedang, dan berat) dengan fasies Na – HCO₃ dan Na – Cl di sepanjang pesisir kelurahan Denasri Wetan – Karangasem – Depok dan pesisir ujung timur Kecamatan Subah.

Kata kunci: data hidrokimia, fasies air tanah, intrusi air laut, geoindikator, distribusi spasial

ABSTRACT

Seawater intrusion as a natural phenomenon had been previously reported occurring in shallow aquifer, which later could be enhanced by Integrated Industrial Complex (KIT) and Coal-fired Steam Power Plant (PLTU) construction in Batang Regency implicating on population growth and a subsequent increase in human activities especially water needs, causing disruptive state such as overpumping in industrial or the surrounding residential area. Particular intrusion study is important to understand its spatial distribution through hydrochemical data analysis on groundwater samples that were carried out on intrusion-prone areas, such as coastal areas in the western part of Batang Regency (Batang, Kandeman, Tulis, and Subah county). Field observation were conducted to acquire geological, geomorphological, and hydrogeological data, to be integrated and analyzed further with water geochemistry data that were obtained namely pH, electroconductivity (EC), total dissolved solids, and temperature. Ion Chromatography and titration analysis also being used to determine major ions and selected minor ions (bromide) concentration altogether with Mohr volumetric method to determine chloride (Cl) content within bulk soil samples. Aspect of intrusion can be decided from SWI (Sea Water Intrusion) Geoindicators for instance, increasing EC and Cl, Cl/Br ratio, Simpson ratio, Na/Cl ratio, BEX index, EC vs Cl plot, SMI index, TDS vs depth and Piper diagram, HFE-D diagram, and CAI index. Nitrate contamination and soluble salts effect on groundwater also being considered to further implies the effect of intrusion on aquifer. The main fundamental of this study is the determination of confirmed geoindicators in each sample and its distribution, and the integration of all data into an aquifer conceptual model.

The results showed that the research area is geologically and geomorphologically comprised of volcanic breccia and tuffaceous sandstone with tuffaceous siltstone interbed in the lower slope of volcanic hills unit, also alluvium of sandy clay composing the alluvial plain unit and fine sand on the coastal plain unit. Hydrogeological observation indicating a relatively shallow groundwater level in range from 0,1 – 24 meters below surface, with its flow relatively heading south – north. Groundwater facies varies from Ca, Mg – HCO₃, Na – HCO₃, and Na – Cl, in that order, further towards to the coast, and increasing EC-TDS value and ion concentration significantly also observed on the western and eastern coastal part of study area with *direct ion exchange* mainly occurring and influencing water chemistry, replacing Na – K on aquifer with Ca – Mg on groundwater. Classification on seawater intrusion showed that normal freshwater dominating the study area with Ca – HCO₃ dan Na – HCO₃ facies and intruded groundwater mainly distributed around the western and eastern coastal areas (separated into slightly, moderately, and severely intruded) with Na – HCO₃ and Na – Cl facies along the coast of Denasri Wetan – Karangasem – Depok and the eastern tip of study area within Subah County.

Keywords: hydrochemical data, groundwater facies, seawater intrusion, geoindicators, spatial distribution