INTISARI

Pengembangan Pembangkit Listrik Tenaga Panas Bumi (PLTP) di Indonesia terus didorong untuk mendukung target energi terbarukan, termasuk di wilayah kerja panas bumi Garut dan Tasikmalaya yang dikelola PT Pertamina Geothermal Energy. Salah satu tahapan krusial sebelum sumur produksi dioperasikan adalah uji produksi sumur (*well testing*), yang melepaskan fluida panas bumi dua fasa ke atmosfer sehingga gas yang tidak dapat dikondensasikan, termasuk hidrogen sulfida (H_2S), turut terlepas dalam konsentrasi tinggi, sehingga menuntut kajian prediktif mengenai pola sebaran dan konsentrasinya di udara ambien. Penelitian ini bertujuan memvalidasi kinerja model AERMOD dalam memprediksi sebaran konsentrasi H_2S, menganalisis pola sebaran emisi menara pendingin dan uji produksi sumur terhadap baku mutu udara, mengevaluasi pengaruh musim dan tata guna lahan terhadap konsentrasi maksimum H_2S, menganalisis kapasitas asimilasi (*assimilative capacity*) atmosfer, serta merumuskan strategi mitigasi berupa waktu pelaksanaan uji produksi sumur yang tepat.

Metode penelitian dilakukan melalui pemodelan dispersi Gaussian menggunakan *software* AERMOD View 13.0.0, dengan input data meteorologi reanalisis ERA5 dan data inventarisasi emisi menara pendingin serta uji produksi sumur. Teknik analisis meliputi validasi model melalui koefisien korelasi dan *Root-Mean-Square-Deviation*, *Two-Way* ANOVA untuk menguji pengaruh musim dan tata guna lahan, serta perhitungan koefisien ventilasi untuk menilai kapasitas asimilasi atmosfer.

Hasil penelitian menunjukkan model AERMOD mampu memprediksi sebaran H_2S ($r = 0{,}978$; RMSD = 0,245), dengan pola sebaran dominan ke arah barat laut, dan seluruh reseptor memenuhi baku mutu pada semua skala waktu rata-rata. Faktor musim berpengaruh signifikan ($p = 0{,}023$) terhadap konsentrasi maksimum H_2S, sedangkan tata guna lahan tidak signifikan ($p = 0{,}904$). Koefisien ventilasi (VC) terbukti menjadi determinan yang lebih presisi terhadap variasi konsentrasi dibanding musim, dengan korelasi Pearson kuat ($r = -0{,}996$ pada rata-rata 1 jam). Kapasitas asimilasi tertinggi terjadi pada sore hari dan periode Juli-Oktober, sehingga uji produksi sumur direkomendasikan dijadwalkan pada periode tersebut untuk meminimalkan risiko pelampauan baku mutu H_2S.

Kata kunci : hidrogen sulfida (H_2S), AERMOD, uji produksi sumur, panas bumi, *assimilative capacity*

ABSTRACT

The development of Geothermal Power Plants (GPP) in Indonesia continues to be encouraged to support renewable energy targets, including in the Garut and Tasikmalaya geothermal working areas managed by PT Pertamina Geothermal Energy. Prior to commercial operation, production wells undergo well testing, releasing two-phase geothermal fluid directly to the atmosphere, causing non-condensable gases, including hydrogen sulfide (H_2S), to be released at high concentrations and requiring predictive assessment of its dispersion and concentration in ambient air. This study aims to validate the AERMOD model in predicting H_2S dispersion, analyze dispersion patterns from cooling tower and well testing emissions against air quality standards, evaluate the effects of season and land use on maximum H_2S concentration, analyze atmospheric assimilative capacity, and formulate a mitigation strategy through optimal well testing scheduling.

The research method employed Gaussian dispersion modeling using AERMOD View 13.0.0 software, with inputs comprising ERA5 reanalysis meteorological data and emission inventory data from cooling tower and well testing sources. Data analysis included model validation through correlation coefficient and Root-Mean-Square-Deviation, Two-Way ANOVA to examine the effects of season and land use, and ventilation coefficient calculation to assess atmospheric assimilative capacity.

The results show that the AERMOD model is capable for predicting H_2S dispersion ($r = 0.978$; RMSD = 0.245), with dispersion dominantly directed northwestward, and all receptors remaining within air quality standards across all averaging times. Season significantly affected maximum H_2S concentration ($p = 0.023$), while land use had no significant effect ($p = 0.904$). The ventilation coefficient (VC) proved a more precise determinant of concentration variation than season, with a strong Pearson correlation ($r = -0.996$ for the 1 hour average). The highest assimilative capacity occurred in the afternoon and during July-October, so well testing scheduling within that period is recommended to minimize the risk of exceeding H_2S air quality standards.

***Keywords** : hydrogen sulfide (H_2S), AERMOD, well testing, geothermal, assimilative capacity*