Karakterisasi Pengaruh Posisi *Exhaust* Dapur pada Konsentrasi Bocoran Gas LPG Guna Mencegah Terjadinya Kebakaran Dapur Menggunakan Simulasi Komputasi Dinamika Fluida

Muhammad Rafi

20/460226/TK/50815

Diajukan kepada Departemen Teknik Nuklir dan Teknik Fisika Fakultas Teknik
Universitas Gadjah Mada pada 5 Juni 2024
untuk memenuhi sebagian persyaratan untuk memperoleh derajat
Sarjana Program Studi Teknik Fisika

INTISARI

Kebakaran dapur akibat kebocoran gas LPG dari tabungnya masih terus terjadi hingga saat ini di Indonesia sehingga menjadi tantangan Nasional untuk diselesaikan. Kurangnya mekanisme pengenceran konsentrasi akumulasi bocoran gas LPG di dapur yang memadai menjadi penyebab bocoran gas LPG melampaui konsentrasi bisa terbakar bawah (LFL) yang dapat terbakar apabila dikenai penyulutan. Pada penelitian ini dilakukan karakterisasi posisi *Exhaust* dapur menggunakan simulasi komputasi dinamika fluida (KDF) guna mendapatkan model mekanisme pengenceran di dapur yang dapat mencegah akumulasi bocoran gas mencapai konsentrasi bisa terbakar bawah.

Simulasi KDF dijalankan pada perangkat lunak ANSYS Fluent. Karakterisasi *Exhaust* dilakukan dengan menganalisis konsentrasi akumulasi bocoran gas LPG di dapur secara visual dan numerik berdasarkan hasil simulasi KDF pada setiap model dan variasi kondisi dapur.

Hasil penelitian menunjukkan bahwa berhasil didapatkan karakteristik terbaik *Exhaust* berdasarkan posisinya yang dapat mencegah akumulasi bocoran gas LPG mencapai konsentrasi bisa terbakar bawah (LFL). Variasi A model 2 menjadi karakteristik yang terbaik dalam menurunkan konsentrasi akumulasi bocoran gas LPG di dapur. Konsentrasi akumulasi gas LPG rata-rata di dalam ruangan selama 120 detik pada variasi A model 2 adalah $9{,}01\times10^{-6}$ dengan konsentrasi tertinggi sebesar $1{,}17\times10^{-2}$, yang mana itu < C_{LFL} sebesar $3{,}3\times10^{-2}$.

Kata kunci: Kebakaran dapur, konsentrasi LPG, *exhaust* dapur, komputasi dinamika fluida (KDF).

Pembimbing Utama : Dr. Ir. Haryono Budi Santosa, M.Sc.

Pembimbing Pendamping : Ir. Kutut Suryopratomo, M.T., M.Sc.

Characterization of the Effect of Kitchen *Exhaust* Position on the Concentration of LPG Gas Leaks to Prevent Kitchen Fires Using Fluid Dynamics Computational Simulations

Muhammad Rafi

20/460226/TK/50815

Submitted to the Departement of Nuclear Engineering and Engineering Physics
Faculty of Engineering Universitas Gadjah Mada on June 5th, 2024
in partial fulfillment of the requirement for the Degree of
Bachelor of Engineering in Engineering Physics

ABSTRACT

Kitchen fires due to LPG gas leaks from cylinders still continue to occur today in Indonesia, making it a national challenge to resolve. The lack of an adequate mechanism for diluting the concentration of accumulated LPG gas leaks in the kitchen is the cause of LPG gas leaks to exceed the lower flammability limit (LFL) concentration which can catch fire if exposed to an ignition. In this research, a characterization of the position of the kitchen *Exhaust* was carried out using computational fluid dynamics (CFD) simulation in order to obtain a model of the dilution mechanism in the kitchen which can prevent the accumulation of gas leaks from reaching below combustible concentrations (LFL).

CFD simulations were run on ANSYS Fluent software. *Exhaust* characterization is carried out by analyzing the concentration of accumulated LPG gas leaks in the kitchen visually and numerically based on CFD simulation results for each model and variations in kitchen conditions.

The research results show that the best exhaust characteristics have been obtained based on its position which can prevent the accumulation of LPG gas leaks from reaching lower flammability limit (LFL) concentrations. Variation A model 2 has the best characteristics in reducing the concentration of accumulated LPG gas leaks in the kitchen. The average accumulated concentration of LPG gas in the room for 120 seconds in variation A model 2 is $9{,}01\times10^{-6}$ with the highest concentration being $1{,}17\times10^{-2}$, which is $< C_{LFL}$ of $3{,}3\times10^{-2}$.

Keywords: *Kitchen fires, LPG concentrations, kitchen exhaust, computational fluid dynamics (CFD).*

Supervisor : Dr. Ir. Haryono Budi Santosa, M.Sc.

Co-supevisor : Ir. Kutut Suryopratomo, M.T., M.Sc.