INTISARI

Deflagration-to-detonation transition (DDT) merupakan proses perubahan pembakaran di mana proses pembakaran dengan kecepatan *subsonic* (deflagrasi) menjadi *supersonic* (detonasi). Terjadinya detonasi selalu ditandai dengan berhimpitnya *reaction front* dengan *shock front*. Jarak DDT atau yang disebut dengan *Detonation Induction Distance* (DID) adalah jarak yang ditempuh oleh gelombang deflagrasi hingga berubah menjadi gelombang detonasi dari *ignition point*. DDT sangat penting untuk memprediksi terjadinya detonasi pada suatu posisi, yang biasanya digunakan *Pulse Detonation Engine* (PDE). Selain itu, PDE juga bermanfaat untuk mendesain *detonation arrester*. Proses DDT dipengaruhi faktor-faktor seperti jenis *fuel, equivalence ratio* campuran, diameter pipa uji, kondisi awal tekanan, energi inisiasi, penggunaan *turbulizing element*, penambahan *highly detonable gas* dan lokasi inisiasi.

Penelitian ini dilakukan untuk menginvestigasi efek Shchelkin spiral terhadap proses DDT dan DID serta pengaruh-pengaruh lain yang ditimbulkan saat terjadi detonasi. Pada penelitian ini, Shchelkin spiral divariasikan jarak *pitch* 15 mm dan 35 mm serta terbagi menjadi 3 konfigurasi, yaitu tunggal, rangkap 2, dan rangkap 3 dengan *blockage ratio* 0,29; 0,50; dan 0,62. Shchelkin spiral dimasukkan pada pipa uji berpenampang lingkaran berdiameter inlet 50 mm, lalu dilakukan percobaan dengan menginjeksi campuran bahan bakar hidrogen-oksigen yang homogen pada rasio ekivalensi 1 dan variasi tekanan awal 30, 60, dan 90 kPa yang merepresentasikan tekanan rendah, sedang, dan tinggi.

Dari hasil penelitian didapatkan pada saat detonasi terjadi, tekanan *shock front* menukik drastis 16 hingga 27 kali tekanan awalnya, ukuran sel detonasi semakin membesar saat tekanan awal yang dimasukkan semakin rendah dan jarak terjadinya DDT menjadi sangat pendek, 4 hingga 8 kali lebih pendek daripada tanpa menggunakan Shchelkin spiral.

Kata kunci**:** DDT, DID, *shock front*, *reaction front*, detonasi, Shchelkin spiral

ABSTRACT

Deflagration-to-detonation transition (DDT) is a combustion process from subsonic combustion wave propagation (deflagration) become supersonic combustion wave propagation (detonation). Detonation is always marked by the reaction front that couple with the shock front. The DDT distance or so-called Detonation Induction Distance (DID) is the distance traveled by the deflagration wave to change become detonation wave from the ignition point. DDT is very important to predict the position of detonation, which is usually used a Pulse Detonation Engine. In addition, PDE is also useful for designing detonation arrester. The DDT process is influenced by many factors such as fuel type, equivalence ratio, test pipe diameter, initial pressure conditions, initiation energy, turbulent element use, highly detonable gas addition and initiation location.

This study was undertaken to investigate the effects of Shchelkin spiral against DDT process and DID and other effects caused during detonation. In this study, Shchelkin spiral varied pitch distance 15 and 35 mm and divided into 3 configurations, they are single, double, and triple with blockage ratio 0.29; 0.50; and 0.62. The Shchelkin spiral was inserted into a 50 mm inlet diameter pipe test tube, then experimented with injecting a homogeneous hydrogen-oxygen fuel mixture at an equivalence ratio of 1 and an initial pressure variation of 30, 60, and 90 kPa representing low, medium, and high pressures.

From the study, we obtained that at the time of detonation, the shock front raised dramatically 16 to 27 times from the initial pressure, the size of the detonation cell grew larger as the initial pressure was lowered and the DID became very short, 4 to 8 times shorter than without Shchelkin spiral.

Keywords: DDT, DID, shock front, reaction front, detonation, Shchelkin spiral