INTISARI

Metana merupakan bahan bakar yang sering digunakan dalam proses industri. Namun, reaksi pembakaran gas metana dapat menghasilkan gelombang detonasi. Jika detonasi tidak dikontrol maka dapat terjadi ledakan dan akan berbahaya untuk keselamatan pekerja maupun fasilitas industri. Penelitian ini dilakukan untuk mengembangkan prototipe *detonation arrester* yang mampu mengontrol gelombang detonasi.

Penelitian dengan bahan bakar CNG-oksigen dilakukan pada pipa uji detonasi (PUD) dengan panjang 3000 mm. PUD terbagi menjadi tiga bagian, yaitu pipa *driver*, pipa *driven upstream*, dan pipa *driven downstream* dengan panjang masing-masing bagian 1000 mm. Bagian depan pipa *driver* terdapat *igniter* yang digunakan untuk menginiasi pembakaran. *Detonation arrester* dipasang pada housing sepanjang 100 mm pada posisi 2000 mm dari *igniter*. Pipa *driver* diisi gas hidrogen-oksigen dengan tekanan awal 100 kPa dan pipa *driven* diisi dengan gas CNG-oksigen (*equivalence ratio* 1, 1,33, dan 0,5) dengan variasi tekanan awal 10-100 kPa dengan interval 10 kPa. Karakteristik gelombang pembakaran diidentifikasi dengan menggunakan sensor tekanan, sensor *ion probe*, dan plat *soot track record*.

Dengan naiknya tekanan awal, kecepatan gelombang pembakaran dan tekanan *shock wave* semakin besar dan ukuran sel detonasi semakin kecil. *Equivalence ratio* 1 mampu menghasilkan tekanan *shock wave* yang mendekati tekanan CJ, sedangkan pada *equivalence ratio* 1,33 dan 0,5 tekanan shock wave berada di bawah tekanan CJ. Kecepatan gelombang pembakaran mempunyai nilai terbesar saat pengujian dengan *equivalence ratio* 1, 1,33 dan 0,5 secara berurutan. Penggunaan *arrester* mampu menurunkan tekanan *shock wave* dan kecepatan gelombang pembakaran serta menaikkan ukuran sel detonasi. Pada pembakaran *equivalence ratio* 1 *detonation quenching* terjadi pada tekanan awal 20 kPa, selain pada kondisi ini terjadi fenomena *detonation reinitiation. Arrester* mampu meredam gelombang detonasi di seluruh tekanan awal pada pengujian *equivalence ratio* 1,33 dan 0,5.

Kata kunci: tekanan awal, *equivalence ratio, detonation arrester, detonation quenching, detonation reinitiation*.

ABSTRACT

Methane is a fuel that is often used in industrial processes. However, the combustion reaction of methane gas can produce a detonation wave. If the detonation is not controlled, an explosion can occur, and it will be dangerous for the safety of workers and industrial facilities. This research was conducted to develop a prototype of a detonation *arrester* which can control detonation waves.

Research with CNG-oxygen fuel was carried out on a detonation test pipe with a length of 3000 mm. The test pipe is divided into three parts, namely driver pipe, driven pipe upstream, and driven pipe downstream with a length of each section of 1000 mm. At the front side of the driver pipe, there is an igniter that is used to initiate combustion. The detonation *arrester* is installed in the housing with a length of 100 mm located at 2000 mm from the igniter. Driver pipe filled with hydrogen-oxygen gas with an initial pressure of 100 kPa and driven pipe filled with CNG-oxygen gas (equivalence ratio of 1, 1.33, and 0.5) with an initial pressure variate from 10 to 100 kPa with an interval of 10 kPa. The characteristics of the combustion wave are identified using a pressure sensor, an *ion probe* sensor, and a soot track record plate.

As the initial pressure increases, the speed of the combustion wave and the shock wave pressure increases, and the size of the detonation cell becomes smaller. The equivalence ratio of 1 can produce a shock wave pressure that is close to CJ pressure, while at an equivalence ratio of 1.33 and 0.5 the shock wave pressure is under CJ pressure. The combustion wave velocity has the greatest values when tested with an equivalent ratio of 1, 1.33 and 0.5, respectively. The use of *arreste*rs can reduce the shock wave pressure and combustion wave velocity and increase the size of detonation cells. At a burning equivalence ratio of 1, detonation quenching occurs at the initial pressure of 20 kPa, apart from this condition, the detonation reinitiation phenomenon occurs. The *arrester* can absorb detonation waves throughout the initial pressure at testing equivalence ratios of 1.33 and 0.5.

Keyword: initial pressure, equivalence ratio, detonation *arrester*, detonation quenching, detonation reinitiation.