

ABSTRAK

Kompore biomassa yang menggunakan mekanisme *secondary combustion* adalah salah satu teknologi pembakaran yang dikembangkan untuk meningkatkan efisiensi panas dan kualitas pembakaran bahan bakar biomassa berbentuk padat. Penelitian ini bertujuan untuk mengetahui dampak dari tingkat kelembapan bahan bakar pelet kayu terhadap beberapa karakteristik seperti suhu pembakaran, kecepatan pembakaran, efisiensi termal, serta efisiensi uji mendidihkan air atau yang biasa disebut dengan *Water Boiling Test* (WBT) pada kompor biomassa yang menggunakan mekanisme *secondary combustion*. Pengujian dilakukan dengan tiga jenis kadar kelembapan bahan bakar pelet kayu, yaitu kadar kelembapan = 14% (pelet basah), kadar kelembapan = 10,4% (pelet biasa), dan kadar kelembapan = 6,4% (pelet kering). Setiap jenis kelembapan diuji tiga kali secara berulang menggunakan metode *Water Boiling Test* (WBT). Data yang dicatat mencakup profil suhu di ruang bakar primer dan sekunder, suhu air, suhu dinding, serta penurunan massa bahan bakar secara langsung. Penelitian ini menunjukkan bahwa variasi kadar kelembapan sebesar 10,4% menghasilkan suhu ruang bakar primer maksimum rata-rata tertinggi, yaitu 949,66°C. Laju pembakaran rata-rata tertinggi dicapai pada variasi kadar kelembapan 14%, yaitu sebesar 0,191 kg per menit dengan durasi pembakaran terpendek yaitu 5,33 menit, karena penurunan massa bahan bakar tidak hanya terjadi karena pembakaran karbon, tetapi juga karena penguapan air yang ada dalam pelet. Efisiensi termal rata-rata tertinggi dicapai oleh variasi kadar kelembapan 6,4% dengan nilai 54,74%, sedangkan efisiensi WBT rata-rata tertinggi dicapai oleh variasi kadar kelembapan 10,4% dengan nilai 37,68%. Penelitian ini menunjukkan bahwa tingkat kelembapan pada bahan bakar memengaruhi secara signifikan karakteristik pembakaran serta efisiensi termal kompor biomassa melalui mekanisme *secondary combustion*.

Kata kunci: kompor biomassa, *secondary combustion*, kadar kelembapan, efisiensi termal, *Water Boiling Test*

ABSTRACT

Biomass stoves that use a secondary combustion system are one of the combustion technologies developed to improve thermal efficiency and the combustion quality of solid biomass fuels. This study aims to understand the impact of wood pellet fuel moisture content on several characteristics such as combustion temperature, combustion rate, thermal efficiency, and water boiling test (WBT) efficiency in a biomass stove that uses a secondary combustion mechanism. Testing was conducted with three moisture content levels of wood pellet fuel: MC = 14% (wet pellets), MC = 10.4% (standard pellets), and MC = 6.4% (dry pellets). Each moisture content level was tested three times using the Water Boiling Test (WBT) method. The recorded data were temperature profiles in the primary and secondary combustion chambers, water temperature, wall temperature, and direct fuel mass loss. This study showed that the 10.4% MC variation produced the highest average maximum primary combustion chamber temperature, namely 949.66°C. The highest average combustion rate was achieved at an MC variation of 14%, amounting to 0.191 kg per minute with the shortest combustion duration of 5.33 minutes, as the fuel mass loss occurred not only due to carbon combustion but also due to the evaporation of water present in the pellets. The highest average thermal efficiency was achieved by the MC = 6.4% variation, with a value of 54.74%, while the highest average WBT efficiency was achieved by the MC = 10.4% variation, with a value of 37.68%. This study shows that the moisture content of the fuel significantly affects the combustion characteristics and thermal efficiency of the biomass stove through the mechanism of secondary combustion.

Keywords: biomass stove, secondary combustion, moisture content, thermal efficiency, Water Boiling Test