

## ABSTRAK

Salah satu teknologi yang sekarang ini banyak diminati di kalangan rumah tangga adalah *water heater*. Selain kebutuhan rumah tangga, *water heater* banyak digunakan untuk kebutuhan rumah sakit, hotel dan industri.

Penelitian ini dilaksanakan di Laboratorium Program Studi Teknik Mesin Sanata Dharma Yogyakarta. Penelitian ini bertujuan untuk (a) merancang dan membuat *water heater* tenaga gas LPG, (b) mendapatkan hubungan antara debit air yang mengalir dengan suhu air keluar *water heater*, (c) mendapatkan hubungan antara debit air dengan laju aliran kalor, (d) Menghitung kalor yang diterima air, (e) menghitung kalor yang diberikan gas LPG, (f) menghitung efisiensi *water heater*.

*Water heater* yang dibuat memiliki dimensi tinggi 37 cm, diameter tabung paling luar 34 cm, diameter tabung tengah 26 cm, diameter tabung paling dalam 9 cm, selimut diameter luar memiliki jumlah lubang udara 320 dengan diameter lubang 10 mm, selimut diameter tengah memiliki jumlah lubang udara 680 dengan diameter lubang 10 mm, selimut diameter dalam memiliki jumlah lubang udara 221 dengan diameter lubang 10 mm, panjang pipa saluran air 10 meter, diameter dalam pipa saluran air 12,7 mm, dan 8 buah sirip dari pipa tembaga dengan panjang sirip 30 cm dan diameter dalam 12,7 mm. Variasi dilakukan pada tinggi pembukaan tutup gas buang, yaitu sebesar 10 putaran (1 cm), 20 putaran (2 cm), dan 30 putaran (3 cm).

Hasil penelitian memberikan beberapa kesimpulan yaitu (a) *water heater* dengan spesifikasi menggunakan panjang pipa saluran air 10 meter, diameter dalam pipa 0,5 inchi (12,7 mm) dan penambahan penutup gas buang dapat bekerja dengan baik dan mampu bersaing dengan *water heater* yang beredar di pasaran. Pada suhu air keluar untuk mandi yaitu 36 °C – 40 °C debit air keluar yaitu 10,56 liter/menit – 16,5 liter/menit, dengan efisiensi 46,20 % - 48,41 %, (b) hasil terbaik hubungan antara debit air dengan temperatur air yang keluar dari *water heater* dinyatakan dengan persamaan :  $T_o = 91,70 \dot{m}^{-0,31}$ . Persamaan tersebut berlaku untuk nilai  $2,52 < \dot{m} < 36$ . pada tekanan udara pada 1 atm dan pada suhu air masuk 27,8 °C,  $\dot{m}$  adalah debit aliran air dalam liter/menit, (c) hasil terbaik hubungan antara debit air dengan laju aliran kalor yang keluar dari *water heater* dinyatakan dengan persamaan :  $q_{\text{air}} = -5,253 \dot{m}^2 + 211,0 \dot{m} + 8244$ . Persamaan tersebut berlaku untuk nilai  $2,52 < \dot{m} < 36$ . Pada tekanan udara pada 1 atm dan pada suhu air masuk 27,8 °C,  $\dot{m}$  adalah debit aliran air dalam liter/menit, (d) hasil terbaik hubungan antara debit air dengan efisiensi *water heater* yang keluar dari *water heater* dinyatakan dengan persamaan :  $\eta = -0,025 \dot{m}^2 + 1,010 \dot{m} + 39,45$ . Persamaan tersebut berlaku untuk nilai  $\dot{m}$  sebesar  $2,52 < \dot{m} < 36$ . Pada tekanan udara pada 1 atm dan pada suhu air masuk 27,8 °C,  $\dot{m}$  adalah debit aliran air dalam liter/menit, (e) kalor yang diberikan gas LPG sebesar 20,897 kW, (f) kalor yang diterima air paling tinggi sebesar 10,28 kW.

Kata Kunci : *water heater*, *water heater* gas LPG.

## ABSTRACT

One of the technologies that are now in great demand among households is water heater. Besides as a household need, water heater is also used for need of hospitals, hotels and industries.

This research was conducted in Laboratory of Mechanical Engineering Study Program of Sanata Dharma University. This research was aimed to (a) design and make water heater with LPG gas power, (b) obtain the relationship between discharge of water flowing out with the temperature of water out of water heater, (c) obtain the relationship between discharge water with the rate of heat flow, (d) count heat that was accepted by water, (e) count heat that was given by LPG gas, (f) count the efficiency of water heater.

The water heater had dimension of high 37 cm, diameter of outside tube 34 cm, diameter of middle tube 26 cm, diameter of inside tube 9 cm, blanket of outside diameter had 320 numbers of air holes with 10 mm as the diameter of hole, blanket of middle diameter had 680 numbers of air holes with 10 mm as the diameter of hole, blanket of inside had 221 numbers of air holes with 10 mm as the diameter of hole, the length of plumbing was 10 meters, the diameter of plumbing inside was 12,7 mm, and 8 fins from copper pipe with the length of fin was 30 cm and the inside diameter was 12,7 mm. Variation was done at the opening high of exhaust gas cap, it was 10 rounds (1 cm), 20 rounds (2 cm), and 30 rounds (3 cm).

The research provided some conclusions: (a) the water heater with the specification used the length of plumbing 10 meters, diameter of pipe inside 0,5 inches ( 12,7 mm) and the increment of the exhaust gas cap could work well and could compete with others water heater on the market. For took a bath, the water out in the temperature of 36 °C – 40 °C, discharger of water out was 10,56 liters/minutes – 16,5 liters/ minutes, with the efficiency of 46,20 % - 48,41%, (b) the best result of the relationship between discharge of water flowing out and with the temperature of water out of water heater was stated with the equation:  $T_o = 91,70 \dot{m}^{-0,31}$ . That equation occurred for the value of  $2,52 < \dot{m} < 36$ . In the air pressure 1 atm in the temperature of incoming water 27,8 °C,  $\dot{m}$  was the discharger of water in liter/minute, (c) the best result of the relationship between the discharge water with the rate of heat flow that out from water heater was stated with equation:  $q_{\text{air}} = -5,253 \dot{m}^2 + 211,0 \dot{m} + 8244$ . That equation occurred for the value  $2,52 < \dot{m} < 36$ . In the air pressure 1 atm and in the temperature of incoming water 27,8 °C,  $\dot{m}$  was the discharger of water in liter/minute, (d) the best result of the relationship between discharger of water with efficiency of water heater that out from water heater was stated with the equation:  $\eta = -0,025 \dot{m}^2 + 1,010 \dot{m} + 39,45$ . That equation occurred for the value  $2,52 < \dot{m} < 36$ . In the air pressure 1 atm and in the temperature of incoming water 27,8 °C,  $\dot{m}$  was the discharger of water in liter/minute, (e) the heat that was given by LPG gas was 20,897 kW (f) the heat that was accepted by the highest water was 10,28 kW.

Keywords: water heater, water heater with LPG gas.