

# Sintesis dan karakterisasi paduan logam berpori mg ca zn hasil metalurgi serbuk dengan tih<sub>2</sub> sebagai foaming agent = Synthesis and characterization mg ca zn metal alloy foam as powder metallurgy product with tih<sub>2</sub> as foaming agent

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Abstrak

## <b>ABSTRAK</b>

Kebutuhan biomaterial yang semakin tinggi mendorong manusia untuk menciptakan sebuah rekayasa material, sehingga dikembangkanlah material berpori Mg-Ca-Zn dengan TiH<sub>2</sub> sebagai foaming agent. Pembuatan material berpori Mg-Ca-Zn dengan TiH<sub>2</sub> sebagai foaming agent ini menggunakan proses metalurgi serbuk dengan TiH<sub>2</sub> yang tanpa diberi perlakuan panas (TiH<sub>2</sub> untreated) dan diberi perlakuan panas (TiH<sub>2</sub> pre-treated) pada temperatur 450°C selama 2 jam. Pada penelitian ini dilakukan variasi temperatur sinter 500°C, 550°C dan 600°C serta variasi komposisi foaming agent TiH<sub>2</sub> un-treated dan TiH<sub>2</sub> pre-treated sebesar 0,5%; 1,5% dan 3% untuk mengetahui karakteristik material yang meliputi temperatur dekomposisi TiH<sub>2</sub>, porositas logam berpori, struktur mikro, fasa, kekuatan tekan serta laju korosi.

Hasil menunjukkan bahwa foaming agent TiH<sub>2</sub> pre-treated berdekomposisi melepaskan hidrogen pada temperatur 520°C serta menghasilkan pori yang lebih homogen dan stabil karena adanya lapisan oksida yang terbentuk pada partikel TiH<sub>2</sub> pre-treated. Fasa yang terbentuk pada paduan logam Mg-Ca-Zn-TiH<sub>2</sub> un-treated yaitu Mg, Ca<sub>2</sub>Mg<sub>5</sub>Zn<sub>13</sub>, Ca<sub>2</sub>Mg<sub>6</sub>Zn<sub>3</sub>, Mg<sub>2</sub>Ca dan TiH<sub>x</sub>, sedangkan pada paduan Mg-Ca-Zn-TiH<sub>2</sub> pre-treated yaitu Ca<sub>2</sub>Mg<sub>5</sub>Zn<sub>13</sub>, Ca<sub>2</sub>Mg<sub>6</sub>Zn<sub>3</sub>, Mg<sub>2</sub>Ca dan TiH<sub>x</sub>, Ti<sub>3</sub>O, Ti<sub>2</sub>O dan TiH<sub>2</sub>. Peningkatan temperatur sinter dan penambahan komposisi foaming agent pada logam berpori Mg-Ca-Zn dengan TiH<sub>2</sub> un-treated dari 500 ke 550°C mengakibatkan nilai porositas dan laju korosi meningkat, namun nilai kuat tekan menurun, dan pada temperatur sinter 600°C mengakibatkan porositas dan laju korosi menurun tetapi kuat tekan meningkat.

Peningkatan temperatur sinter dan penambahan komposisi foaming agent pada logam berpori Mg-Ca-Zn dengan TiH<sub>2</sub> pre-treated cenderung mengalami peningkatan porositas dan laju korosi, namun menurunkan nilai kuat tekan. Dalam studi ini, hasil yang paling optimal yaitu Paduan Mg-1Ca-3Zn dengan penambahan 3% berat TiH<sub>2</sub> pada temperatur sinter 600°C, dengan porositas sebesar 19,1% serta rata-rata ukuran pori 5-7 μm, kuat tekan 178,85 N/mm<sup>2</sup> dan laju korosi 2,41 mmpy.

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## <i><b>ABSTRACT</b></i>

The increasing demand of biomaterial has been encouraging researchers to engineer a biodegradable material, which lead to development of porous Mg-Ca-Zn with the addition of TiH<sub>2</sub> as a foaming agent. The synthesis of porous Mg-Ca-Zn with the addition of TiH<sub>2</sub> as a foaming agent was performed by powder metallurgy method. The addition of TiH<sub>2</sub> was categorized by those that pre-treated with the heat treatment at 450 °C for two hours and those that untreated. In this study, the sintering process was performed at different temperatures i.e. 500°C, 550°C and 600°C. The amount of TiH<sub>2</sub> addition was varied at 0,5%; 1,5% and 3% in weight to investigate the TiH<sub>2</sub> decomposition temperature, porosity, microstructures, phase

formation, mechanical properties and the corrosion rate.

The characterization results of samples with the addition of pre-treated TiH<sub>2</sub> showed that foaming agent material TiH<sub>2</sub> was decomposed at 520°C and releasing hydrogen to develop stable and homogenous-distributed pores, due to the formation of oxide layers. The X-ray diffraction (XRD) patterns revealed that the phase formation in samples with the addition of untreated TiH<sub>2</sub> were Mg, Ca<sub>2</sub>Mg<sub>5</sub>Zn<sub>13</sub>, Ca<sub>2</sub>Mg<sub>6</sub>Zn<sub>3</sub>, Mg<sub>2</sub>Ca and TiH<sub>x</sub>, while in samples with the addition of pre-treated TiH<sub>2</sub> were Ca<sub>2</sub>Mg<sub>5</sub>Zn<sub>13</sub>, Ca<sub>2</sub>Mg<sub>6</sub>Zn<sub>3</sub>, Mg<sub>2</sub>Ca dan TiH<sub>x</sub>, Ti<sub>3</sub>O, Ti<sub>2</sub>O dan TiH<sub>2</sub>. The increasing of sintering temperatures and foaming agent material content of porous Mg-Ca-Zn alloy with addition of untreated TiH<sub>2</sub> affected the increasing porosity and corrosion rate, despite the lower value of compressive strength.

While the sintering temperature of 600°C gave the decreasing of porosity and corrosion rate but increasing the compressive strength. The increasing of sintering temperature and foaming agent material content of porous Mg-Ca-Zn alloy with addition of pretreated TiH<sub>2</sub> resulted to increasing of porosity and corrosion rate, but lowering the compressive strength. In this study, the optimum sample was found to be Mg-Ca-3Zn with the addition of 3% TiH<sub>2</sub> synthesized at 600°C, owing porosity of 19,1% with the pore sizes of 5-7 μm, compressive strength of 178,85 N/mm<sup>2</sup> corrosion rate of 2,41 mmpy.