

# Studi karakteristik agregat kasar ringan buatan dari limbah botol plastik Polietilen Terephthalate (PET) dan pengaruh agregat kasar ringan buatan tersebut terhadap sifat-sifat mekanis beton ringan = Characteristic study of lightweight coarse aggregate made from waste plastic Polyethylene Terephthalate (PET) bottle and its effect to the mechanical properties of lightweight concrete. / Sony Aria Wiryawan

Sony Aria Wiryawan, author

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## Abstrak

### <b>ABSTRAK</b><br>

Polyethylene terephthalate (PET) merupakan poliester termoplastik yang diproduksi secara komersial melalui produk kondensasi. PET adalah bahan dasar dari botol plastik dengan berat jenis berkisar antara 0,92-0,96 dan akan mengeras bila dipanaskan. Berdasarkan karakteristik fisik dari PET, dalam studi ini telah dilakukan penelitian limbah botol plastik PET sebagai bahan baku pembuatan agregat kasar ringan dan menggunakannya dalam campuran beton ringan. Agregat kasar ringan dihasilkan dari pembakaran botol PET, hasil pembakaran diperoleh agregat dengan bentuk tidak beraturan dan bersudut dengan tekstur permukaan halus. Karakteristik geometrik agregat ringan tersebut menyerupai agregat kasar pada umumnya. Pengujian sifat fisik agregat diperoleh berat jenis sebesar 1,316, penyerapan air 1,140%, berat isi 820 kg/m<sup>3</sup>, dan keausan agregat 28,40%. Dari pengujian kuat tekan hancur agregat terhadap 2 ukuran spesimen kubus diperoleh kuat tekan hancur agregat plastik kubus (5\_5\_5) cm lebih besar 1,06 kali dibandingkan dengan kubus (15\_15\_15) cm. Namun dalam perhitungan rancang campur beton ringan nilai kuat tekan hancur agregat kubus (15\_15\_15) cm yang digunakan. Dalam studi ini, agregat ringan plastik dan agregat halus normal (pasir alam) diklasifikasikan berdasarkan ukuran spesimen kubus yang digunakan yaitu kubus beton (5\_5\_5) cm dan (15\_15\_15) cm sehingga diperoleh beton ringan agregat bergradasi normal dan beton ringan agregat bergradasi modifikasi. Dari hasil pengujian beton ringan agregat plastik meliputi pengujian beton segar dan beton yang telah mengeras memperlihatkan beton segar agregat plastik mempunyai kelecakan yang baik, berat isi kering 1742 kg/m<sup>3</sup>, kuat tekan rata-rata beton ringan bergradasi normal (263,333 ? 270,757) kg/cm<sup>2</sup> dan kuat tekan rata-rata beton ringan bergradasi modifikasi (228,374 ? 263,333) kg/cm<sup>2</sup>. Kuat tekan beton yang didapat dengan menggunakan kuat tekan mortar maksimum masih dibawah kuat tekan target rencana sebesar 287,2 kg/cm<sup>2</sup>, modulus elastisitas sebesar (104612-104642) kg/cm<sup>2</sup>, Poisson's Ratio (0,2201-0,2212). Berdasarkan pada hasil kuat tekan beton ringan terjadi penurunan kekuatan untuk beton ringan dengan spesimen kubus ukuran (5\_5\_5) cm sebesar 0,97 kali lebih kecil dibandingkan dengan beton ringan spesimen kubus ukuran (15\_15\_15) cm, hal ini diperkirakan terjadi karena agregat plastik dengan gradasi yang lebih kecil mempunyai porositas yang besar sehingga berpengaruh pada kuat tekan beton ringan yang dihasilkan. Besarnya porositas yang terjadi pada agregat dengan gradasi yang lebih kecil dikarenakan pola pemecahan yang berulang-ulang pada saat mendapatkan gradasi agregat tersebut dan diperkirakan timbul retak-retak pada struktur dalam agregat. Hal ini dapat dibuktikan dengan pengujian porositas dimana untuk agregat ringan ukuran (6,35-4,75) mm porositasnya sebesar 28,37% sedangkan agregat ringan ukuran (25,4-9,5) mm porositasnya hanya sebesar 12,67%.

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## **ABSTRACT**

Polyethylene terephthalate (PET) is classified as thermoplastic polyester that is commercially produced by condensation system. PET is used as the basic raw material to produce plastic bottle with specific gravity ranging between 0.92-0.96 and will become hardened when it has heated. Based on physical characteristic of PET, this study has been done an investigation about PET as basic raw material for lightweight coarse aggregates and the usage of these aggregates in lightweight concrete. Lightweight coarse aggregates for lightweight concrete produced from burned plastic PET bottle. The shape of aggregates were irregular and angular with smooth surface. The geometric characteristic of aggregates were generally look like of coarse aggregate. The test results of physical properties of aggregates such as specific gravity is 1,316, density is 820 kg/m<sup>3</sup>, and the resistance of abrasion is 28,40%. Aggregates crushing strength result of lightweight coarse aggregate show on a size cube of (5\_5\_5) cm has strength larger by 1,06 times compared to a size cube of (15\_15\_15) cm, but in the calculation of lightweight concrete mixture were used the aggregates crushing strength of cube (15\_15\_15) cm. In this study, lightweight coarse and fine aggregate were classified according to the size of concrete cube so there are two different type of lightweight concrete, a modification and normal grade. Based on test of lightweight concrete including fresh and hardened concrete show that the fresh concrete has good workability, dry weight of concrete 1742 kg/m<sup>3</sup>, the average strength of lightweight concrete with a normal grade were ranging between (263,333-270,757) kg/cm<sup>2</sup> and a modification grade were ranging between (228,374-263,333) kg/cm<sup>2</sup>, strength of concretes results with the used that have maximum strength mortar were still below the target strength equal to 287,2 kg/cm<sup>2</sup>, modulus of elasticity was ranging between (104612-104642) kg/cm<sup>2</sup>, and Poisson's ratio was ranging between (0,2201-0,2212). Based on the result of compressive strength of lightweight concrete, the decrease in strength of concrete cube (5\_5\_5) cm was occurred because of the aggregates that were used have relatively high porosity. High porosity was occurred because of repeatedly crushing process to get smaller aggregates, and its process would cause fracture in interstructure of aggregates. The result of porosity test show that lightweight coarse aggregate with size (6.35-4.75) mm or the smaller ones has porosity 28,37% compared by coarse aggregate with size (25,4-9,5) mm that has porosity only 12,67%.