









TABLE IV. PERMEABILITY OF KAOLIN-PWT MIXTURES AND COHESIVE CLAY – FINE TIRE CHIPS MIXTURES

Kaolin - PWT Mixtures (Current Study)				
Rubber Percentage	0%	20%	40%	60%
Permeability (mm/s)	9.11E-06	3.66E-05	4.71E-05	5.17E-05
Cohesive Clay – Fine Tire Chips Mixtures [6]				
Rubber Percentage	0%	20%	40%	50%
Permeability (mm/s)	9E-08	2.8E-07	4.7E-07	6.5E-07

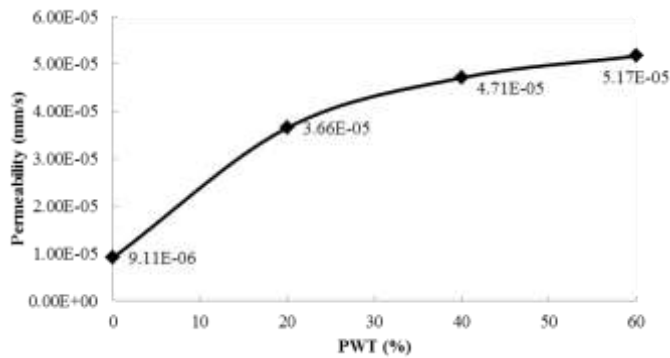


Fig. 5. Permeability of Kaolin-PWT mixture

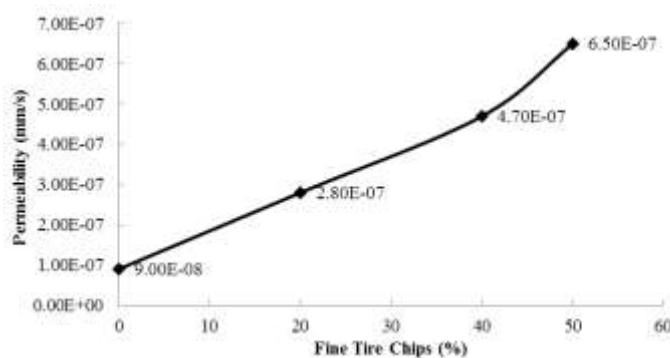


Fig. 6. Permeability of Cohesive Clay – Fine Tire Chips Mixtures [6]

#### IV. CONCLUSIONS

Effect of Powdery Waste Tire (PWT) on permeability of Kaolin was investigated. PWT mixed with Kaolin in different percentages of 0%, 20%, 40% and 60% by weight. Sample preparation was according to British standard. A number of 20

permeability tests were conducted on four different mixtures included pure Kaolin. The results indicated that permeability of Kaolin-PWT mixtures increased up to 467% for 60% of PWT replaced with Kaolin in comparison with pure Kaolin. Therefore, replacing more amount of PWT with Kaolin increases the permeability.

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#### REFERENCES

- [1] Wu, C. C. Benda, and R. F. Cauley. Triaxial Determination of Shear Strength of Tire Chips. *Journal of Geotechnical and Geoenvironmental Engineering*. 1997. 123: 479–482.
- [2] J. H. Lee, R. Salgado, A. Bernal and C. W. Lovel. Shredded Tires and Rubber-Sand as Lightweight Backfill. *Journal of Geotechnical and Geoenvironmental Engineering*. 1999. 125: 132–141.
- [3] S. Yang, R. Lohnes and B. Kjartanson, Mechanical Properties of Shredded Tires. *Geotechnical Testing Journal*. 2002. 25(1): 44–52.
- [4] M. Ghazavi, Shear Strength Characteristics of Sand Mixed with Granular Rubber. *Geotechnical and Geological Engineering*. 2004. 22: 401–416.
- [5] S. Youwai and D. T. Bergado. Numerical Analysis of Reinforced Wall Using Rubber Tire Chips-Sand Mixtures as Backfill Material. *Computers and Geotechnics*. 2004. 31: 103–114.
- [6] H. Cetin, M. Fener and O. Gunaydin. Geotechnical Properties of Tire-Cohesive Clayey Soil Mixtures as a Fill Material. *Engineering Geology*. 2006. 88: 110–120.
- [7] B. Tiwari, B. Ajmera, S. Moubayed, A. Lemmon and K. Styler. Soil Modification with Shredded Rubber Tires. *GeoCongress*. 2012. 3701–3708.
- [8] T. Edil and P. J. Bosscher. Engineering Properties of Tire Chips and Soil Mixtures. *Geotechnical Testing Journal*. 1994. 453–464.
- [9] T. Edeskär, Technical and Environmental Properties of Tire Shreds Focusing on Ground Engineering Applications. 2004.
- [10] C. C. Smith, W. F. Anderson and R. J. Freewood. Evaluation of Shredded Tire Chips as Sorption Media for Passive Treatment Walls. *Engineering Geology*. 2001. 60, 253–261.
- [11] K. Reddy and A. Marella. Properties of Different Size Scrap Tire Shreds: Implications on Using as Drainage Material in Landfill Cover Systems. *The Seventeenth International Conference on Solid Waste Technology and Management*. 2001. (pp. 1–19). Philadelphia, PA, USA.
- [12] V. Cecich, L. Gonzales, A. Hoisaeter, J. Williams and K. Reddy. Use of Shredded Tires as Lightweight Backfill Material for Retaining Structures. *Waste Management and Research*. 1996. 14: 433–451.
- [13] M. Garcia, M. A. Pando and B. Tempest. Tire Derived Aggregates as a Sustainable Recycled Material for Retaining Wall Backfills. *ICSDC*. 2011. (pp. 542–552). ASCE.
- [14] R. Salgado, S. Yoon and Z. Siddiki. Construction of Tire Shreds Test Embankment. 2002.
- [15] British Standard 1377-4. Methods of test for Soils for civil engineering purposes Part 4: Compaction-related tests. British Standard. 1990. (4).
- [16] A. Arefnia, E. Momeni, D. Jahed Armaghani, K. A. Kassim, K. Ahmad. Effect of Tire Derived Aggregate on Maximum Dry Density of Kaolin. *Jurnal Teknologi*. 2014. 66(1): 19–23.