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Data Article

Data on the engineering properties of aluminum dross as a filler in asphalt

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ABSTRACT

Pavement is the backbone of an effective and efficient transportation system. Data on the use of aluminium dross as filler material in the modification of asphalt for a sustainable pavement was espoused. Aluminium dross which is a solid waste from steel production industry was utilized. Data on the engineering and stability properties of the material in enhancing the strength of the asphalt mix design was espoused. This was achieved by adding the solid waste at 0%, 2.5%, 5%, 7.5%, 10% and 12.5% of aluminium dross to the asphalt concrete sample. Marshall Test was used to determine the stability of aluminium dross in flexible pavement and this was used for the selection of asphalt binder content with a suitable density which satisfies minimum stability and range of flow values using AASHTO specification. The data obtained will be of help to researchers, engineers, road construction workers and environmentalist on the use of this solid waste in the construction of sustainable long-lasting roads for national growth and solid waste reduction.

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Specifications Table

Subject area	Transportation Engineering
More specific subject area	Pavement Engineering, Waste Management,
Type of data	Table Image Figure
How data were acquired	Penetration grade test, Ductility test, Chemical test obtained by XRF equipment and Atomic Absorption Spectrometer equipment. Marshall stability determined Marshall testing equipment.
Data format	Raw and Experimental
Parameters for data collection	Data was collected on the experimental analysis of the use of aluminium dross as a filler in the improvement of the strength and stability of asphalt. This was in a bid to reduce the high cost involve in the disposal of this waste with over 1 Million metric tonne generated globally. The waste was used at 0, 2.5. 5, 7.5 and 10% in asphalt production.
Description of data collection	Data on the engineering properties of the modified asphalt was obtained. These include data on the ductility, penetration and the marshall stability. Additionally, data on the chemical composition of the solid waste was also obtained using X-ray Fluorescence (XRF) and Atomic Absorption Spectrometer (AAS) apparatus.
Data source location	Raw Data
Data accessibility	Raw data
Related research article	Not Known

Value of data

- The data obtained here will contribute to the re-use of aluminium dross waste from steel production industry
- The data will be of help to researchers, engineers, road construction workers and environmentalist on the use of this solid waste in road construction
- The data could be used by highway engineers and road construction workers in the effective design of this modified asphalt.
- The data will aid policymakers on the proper use of this in pavement technology in the construction of sustainable roads

There is a great information potential in the application of this waste in the road construction industry. This will help to reduce the negative effect of the improper disposal of the waste [1,2] and its re-use in transportation which is an integral component of national growth [3–5].

1. Data

Aluminium dross (Plate 1) is in abundance, and proper utilization of this waste product will be economical [5-11]. The research of [5-7] revealed common filler materials other than aluminium dross that has been used in the past and are still being used up till date in concrete and asphalt. Based on the findings of [2], it was discovered that aluminium industries create almost five million tons of this waste every year. Aluminium dross has several re-uses as avowed by [2]. This data set assessed the use of the waste in asphalt modification as a filler material.

Ductilometer was used in assessing the ductility of the bitumen before the addition of aluminium dross. Additionally, ball and ring test and penetration test was also carried out on the modified asphalt. This is because the wearing course expands under sunlight and retracts at night. Asphalt compacting machine is used to compact the Marshall Specimen manually for sample preparation. After selecting particle sizes of aggregates with the sieve analysis machine, the optimum bitumen content mix was added thoroughly, and the heated sample was placed inside the mould and the sample was thereafter placed under the compacting machine and the marshal stability equipment.

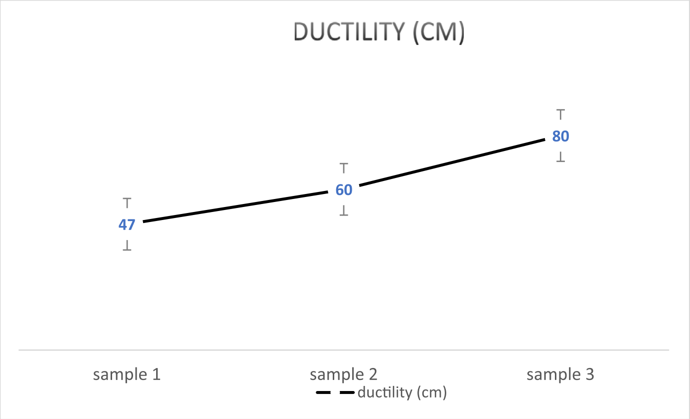

Plate 1. Aluminium dross sample.

Table 1
Data on the Analyte Concentration.

ELEMENT	CONCENTRATION (Wt%)
Na_2O	0.000
MgO	0.931
Al_2O_3	77.172
SiO_2	13.482
P_2O_5	0.000
SO_3	0.700
Cl	0.276
K_2O	0.161
CaO	1.129
ClO_2	1.439
Cr_2O_3	0.071
Mn_2O_3	0.202
Fe_2O_3	4.186
ZnO	0.237
SrO	0.015

Table 1 shows the data on the chemical composition of the solid waste after pulverization Table 2 and 3 contains data on the sieve analysis of the aluminium dross and the aggregates respectively. Fig. 1 showed the data on the Ductility of the samples assessed .Table 4 contains values on the Marshall and Volumetric Properties of Bitumen Content Mix. Fig. 2, Fig. 3 shows Marshall Stability Vs Bitumen Content and Marshall Stability versus Bitumen Content. Fig. 4 shows the results of Bulk density versus Bitumen Content. Table 5 shows the Optimum Bitumen Content. Table 6 shows the data on Comparison of Marshall and Volumetric Properties of Bitumen.

The Bitumen Content samples were prepared at Optimum Bitumen Content with Aluminium dross as a filler it was used at 2.5%, 5%, 7.5% and 10% by weight of aggregates. The volumetric and Marshall properties of these samples were determined and compared.

2. Experimental design and methods

2.1. Materials

Aluminium dross was obtained from an open dumped site in Ado-Odo Ota local government in Ogun State, Nigeria. This material was collected in an airtight container. Bitumen of

Table 2
Data on the sieve analysis of the aggregates.

	Wt of aggregate Retained			% of the total with wt retained	Cumulative% of total wt retained	% passing
	I	II	AV			
19.0mm	69	80	75	7.485	75	92.515
13.2mm	74	68	71	7.085	146	92.915
12.5mm	11	22	17	1.696	163	98.304
9.5mm	64	54	59	5.888	222	94.112
6.3mm	127	128	128	12.774	350	87.226
4.75mm	74	70	72	7.185	422	92.815
2.36mm	180	180	180	17.964	602	82.036
1.00mm	170	180	175	17.465	777	82.535
600mm	108	90	99	9.880	876	90.12
300mm	69	75	72	7.185	948	92.815
150mm	39	37	38	3.792	986	96.208
75mm	12	12	12	1.197	998	98.803
Receiver	3	4	4	0.399	1002	99.601

Table 3
Determination of particle size distribution of coarse aggregate.

I.S Sieve sizes	Weight of Aggregate retained (g)			% of total weight retained	Cumulative% of total weight retained	Cumulative% Passing
	1	2	Average(g)			
19.0mm	31	23	27	2.7	2.7	97.3
13.2mm	252	307	279.5	27.95	30.65	69.35
12.5mm	21	11	16	1.6	32.25	67.75
9.5mm	116	98	107	10.7	42.95	57.05
6.3mm	156	146	151	15.1	58.05	4195
4.75mm	144	138	141	14.1	72.15	27.85
2.36mm	98	97	97.5	9.75	819	18.1
1.00mm	40	40	40	4.0	85.9	14.1
600um	28	27	27.5	2.75	88.65	11.35
300um	74	74	74	7.4	96.05	3.95
150um	34	33	33.5	3.35	99.4	0.6
75um	5	3	4	0.4	99.8	0.2
Receiver	2	2	2	0.2	100.0	0.00

Table 4
Data on the Marshall and Volumetric Properties of Bitumen Content Mix.

Bitumen Content (%)	2.5	5	7.5	10	12.5
Marshall Stability (KN)	14.07	14.97	13.96	13.70	13.22
Flow (mm)	3.15	3.24	4.18	4.16	4.06
Density (g/cm$^{3)}$	2.35	2.35	2.33	2.12	2.04
Vv (%)	4.52	4.05	3.87	3.56	3.44
VFB (%)	67.02	69.40	70.20	70.55	70.89
VMA (%)	13.70	13.20	12.97	12.45	12.13

Table 5
Optimum Bitumen Content.

	Bitumen Content (%)
Max Stability	**5.5**
Max Density	**5.5**
4.5% Air Voids	**5**
Optimum Bitumen Content (OBC)	**5**

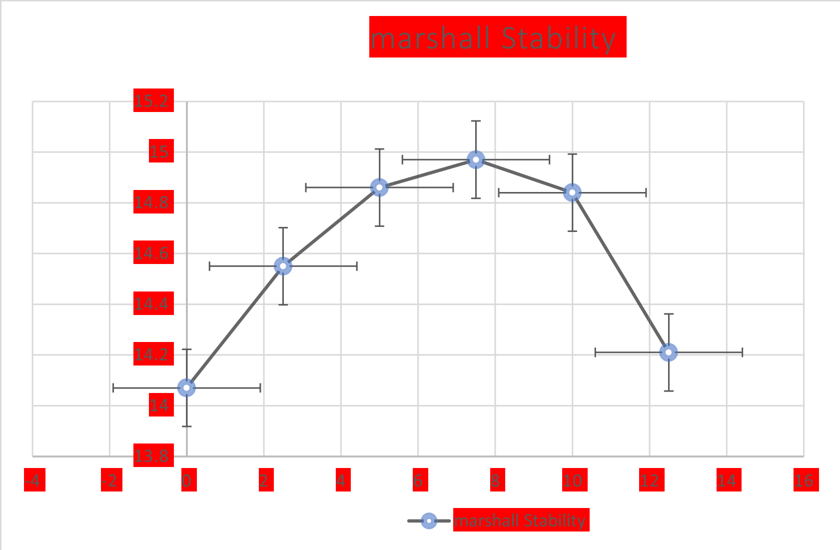

Fig. 1. Data on the Ductility of the samples assessed.

Table 6
Comparison of Marshall and Volumetric Properties of Bitumen.

Aluminium Dross	Marshall stability (KN)	Flow(mm)	Density (g/cc)	Vv (%)	VFB (%)
0	14.07	2.74	1.245	3.6	62.11
2.5	14.55	2.61	1.150	3.8	63.41
5	14.86	2.82	1.130	4.01	68.40
7.5	14.97	2.45	1.160	3.85	67.22
10.0	14.84	2.36	1.236	3.68	60.42

Penetration Grade 60/70 was purchase in Lagos, Nigeria. The Penetration test was carried out to re-affirm the penetration grade. Fine aggregates (river Sand) and coarse aggregate were purchased in a quarry in Ogun State.

2.2. Sample preparation

The aluminium dross was obtained in the raw form and sealed in an airtight bag and air-dried for forty-eight hours (48) before pulverization. Fine aggregate is soil particles that pass through a 4.25 mm sieve and Coarse aggregates of size 4.75 mm were used.

2.3. Test and methods

Wavelength-dispersion X-ray fluorescence spectrometer and atomic absorption spectrometer was used to determine the chemical composition of the waste. Mechanical sieve shaker was used to assess the grain size analysis of both aluminium dross and the aggregates used. This test procedure was used in designing and evaluating bituminous Paving mixes using ASTM standard procedures.

Tests were carried out on the bitumen to determine the rheology. The viscosity test was done according to [12], and the penetration test was also done conferring to the specification of [13].

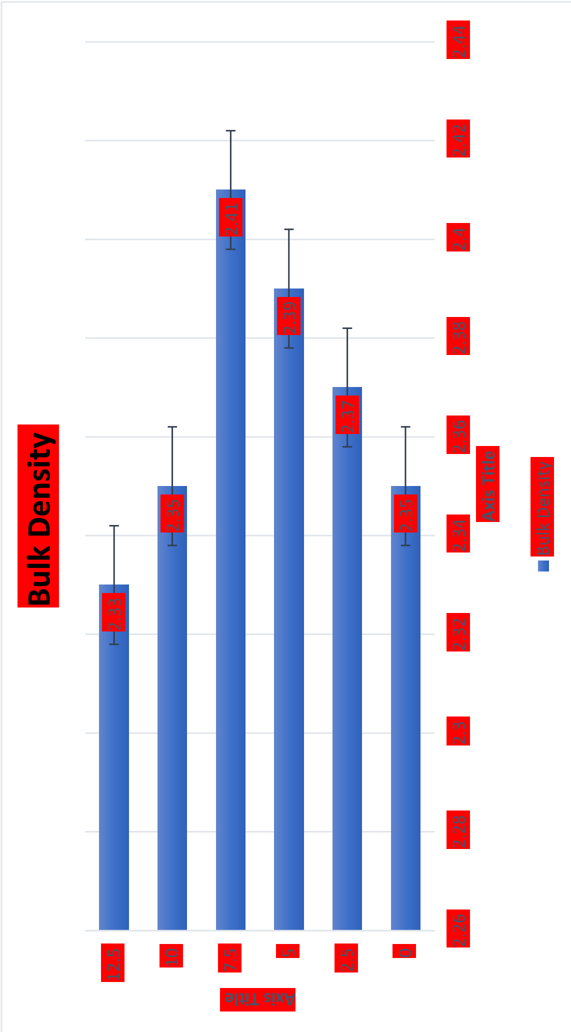

Fig. 2. Marshall Stability Vs Bitumen Content.

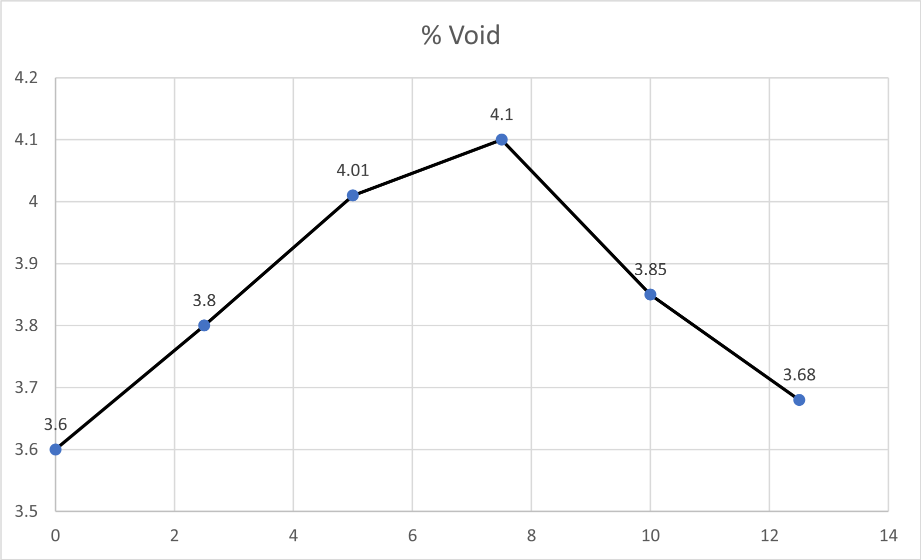

Fig. 3. Bulk density Vs Bitumen Content.

Fig. 4. Percentage Air Void Vs Bitumen Content.

The bitumen was modified with aluminium dross at 0, 2.5, 5, 7.5 and 10% of the bitumen waste. The rheology was then repeated at the percentage additions. Marshall stability was done on the asphalt mixture with the naturally occurring bitumen and the polymer modified bitumen according to [14].

Declaration of Competing Interest

Authors declare no conflict of interest

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.dib.2020.105934.

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