

An Analysis of Road Dust Samples in the United States

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ABSTRACT

In industrial regions, such as those in Northwestern Indiana, raw input, waste, and other products of industry are moved to and from their manufacturing locations, and can affect and be detected in local ecosystems. One method of qualifying the presence of any potentially hazardous industrial byproducts is by sampling the dust which accumulates along roads, called Road Dust Sediments (RDS), and chemically analysing these samples for numerous properties. Road dust, which is a mixture of organic and inorganic compounds, can be used as an indicator for what pollutants are present in a particular area. Through an analysis of samples collected from across the country, we were able to identify various properties of the sediment samples, such as pH, metal presence, organic compound composition, and solubility in water to determine the overall makeup of the samples. Methods used for analysis of RDS samples included Liquid Chromatography (LC), Infrared Spectroscopy (IR), X-ray Fluorescence (XRF), pH determination, organic carbon analysis, and visual analysis using a microscope. Overall, the results seemed to indicate a higher level of pollutants in areas closer to industry compared to areas more removed from industry.

METHODS

XRF	pH	Organic Carbon	Ion Chromatography	Visual (Microscopic)
X-Ray Fluorescence analysis uses x-rays to ionise materials, and then collects data on the resulting fluorescence to determine metal composition	A potentiometric pH meter collects data regarding the difference in electrical potential between two electrodes in a water-based solution to determine the pH of a sample	By massing a sample before heating, then placing it in an oven at 500°C, organic carbon is burned away, and the remaining mass can be used to determine the organic carbon composition of the original sample	Ion chromatography separates ions based on their varying affinities to an ion exchanger, which differs by factors like charge and polarity, to determine the concentration of known ions in solution	By examining samples under a digital stereo microscope, the coarse composition of samples can be determined, including factors such as the presence of microplastics

XRF Data

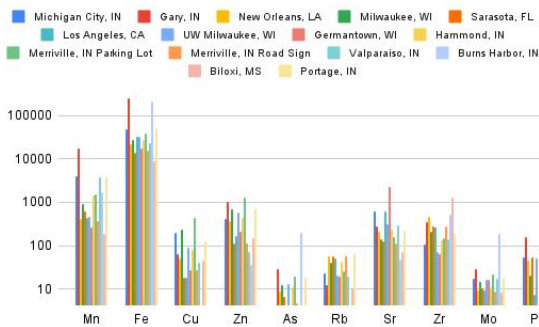


Fig. 1 Concentrations of metals in fine particle fractions of RDS determined using XRF

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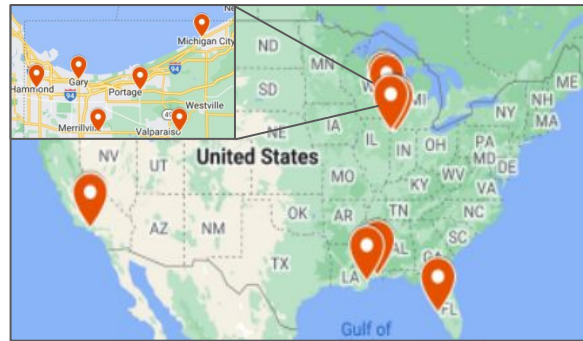


Fig. 2 All RDS sampling locations across the US

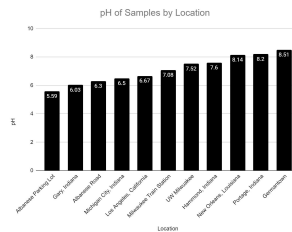


Fig. 3 pH of water soluble RDS

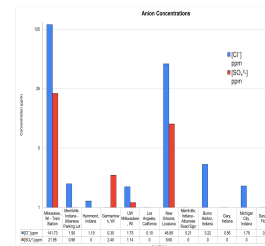


Fig. 4 Chloride and sulfate concentrations of water soluble RDS

Northwest Indiana XRF

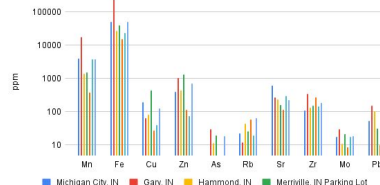


Fig. 5 Localized XRF Data

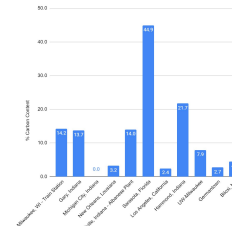


Fig. 6 Organic carbon content of samples

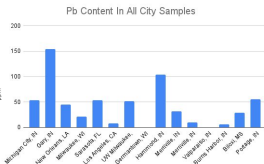
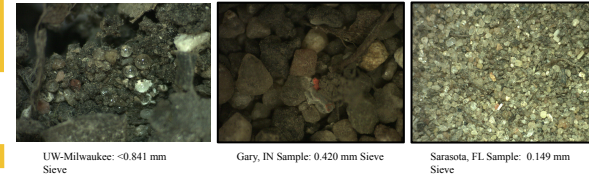
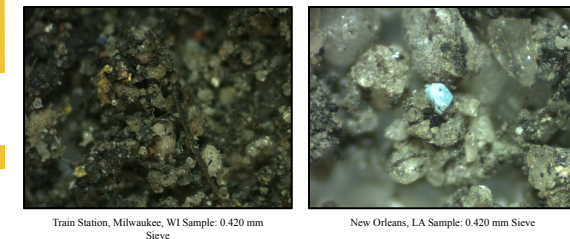


Fig. 7 Pb and Fe content in city RDS Samples

Stereomicroscope Photos (4-40X)



Unusual Particles Found in Fine Sediment Samples From Different Locations



CONCLUSIONS/DISCUSSION

- The composition of RDS is diverse, and varies geographically.
- RDS can be one means to assess local environmental health.
- Visual analysis under a microscope revealed the presence of numerous abnormalities in the samples, including contamination by microplastics, glass beads, and other unnatural particles.
- The RDS taken from highly industrial areas (Gary, Portage, Hammond, Michigan City) tended to have higher Pb and Fe concentrations than less industrial areas.
- The pH of solutions containing RDS from industrial or urban areas tended to be acidic or neutral, while the pH of solutions containing RDS from less urban areas tended to be slightly basic.
- RDS content tends not to vary by broad location. It instead varies according to the immediate surroundings of the sample.

REFERENCES

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