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DETECTING HOT AREAS IN DUMPS WITH A HANDHELD, INFRARED SCANNER

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A portable, handheld infrared scanner has been used to detect abnormal surface temperatures on dumps of flood-generated trash near Wilkes-Barre, Pa. Three of eight dumps examined had thermal anomalies on the surface indicating temperature buildup at depth. The anomalies found with the scanner were verified by measurements with a thermocouple probe or a carbon monoxide detector. One week after the investigation was completed, open fire broke out at the site of one of these thermal anomalies; about 6 weeks after the investigation a thermal anomaly in another dump was verified when a trench was excavated in the dump.

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by

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ABSTRACT

A portable, handheld infrared scanner has been used to detect abnormal surface temperature on dumps of flood-generated trash near Wilkes-Barre, Pa. Three of eight dumps examined had thermal anomalies on the surface, indicating temperature buildup at depth. The anomalies found with the scanner were verified by measurements with a thermocouple probe or a carbon monoxide detector. One week after the investigation was completed, open fire broke out at the site of one of these thermal anomalies; about 6 weeks after the investigation, a thermal anomaly in another dump was verified when a trench was excavated in the dump.

INTRODUCTION

Fires burning in waste dumps and piles of combustible debris in populated areas are both hazardous and obnoxious. For this reason, and because dumps of commercial, municipal, or household waste are highly susceptible to burning, eight large dumps of flood-generated trash near Wilkes-Barre, Pa., were examined with portable, handheld infrared equipment. The objective of the investigation was to detect abnormal surface temperatures on the dumps which might be associated with existing subsurface fires or with areas of potential spontaneous combustion.

Several investigators (2, 4)[2] have shown the feasibility of using airborne infrared instrumentation for detecting abnormal surface temperatures that are associated with buried fires in spoil banks, underground coal mines, and associated outcrops. Large areas of the country have now been surveyed with airborne instrumentation for the purpose of detecting and mapping such fires (3). When dumps are new or efforts to extinguish a fire either are in progress or have recently been completed, repeated investigations may be necessary. The cost of repeated overflights may be prohibitive; for this reason handheld infrared instruments are being evaluated (5-6) for detection of surface thermal anomalies.

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[1] Geophysicist.

[2] Underlined numbers in parentheses refer to items in the list of references at the end of this report.

The absence of temperature anomalies on the surface of the dump does not eliminate the possibility of fire or temperature buildup existing beneath the surface. Obviously, some time is required for heat from the "hot spots" to be conducted through the overlying cover. Because the thermal properties of the material and the depth of possible "hot spots" were unknown, it was not possible to determine the time necessary for heat to be conducted to the surface. Also, if the heat transfer were by convection, it was expected that the "hot spots" would be expressed on the surface soon after they developed. Therefore, it was desirable to verify the results obtained with the scanner by other measurements or by uncovering the thermal anomalies.

INSTRUMENTS AND PROCEDURES

The primary instrument used in this investigation is a handheld thermal imager (fig. 2), commonly called an infrared scanner, which was originally developed for military use as a night vision device. Because it is a passive instrument, designed to detect radiation emitted by relatively weak thermal targets, it performs well in detecting surface heat from buried fires. One of the more important requirements is the need for a line-of-sight to the target.

The scanner is small in size (10 inches wide by 5.5 inches high by 3.5 inches deep) and weighs 6 pounds. It is powered by a 6-volt, silver-zinc battery that is normally worn on a belt; it can be used in almost any location that is accessible to man. Electronically cooled, lead selenide detectors make possible the detection of temperature differences as small as 0.1° to 0.2° C. This sensitivity is more than adequate for the detection of thermal anomalies associated with most buried fires.

When using the scanner, the operator views a thermal image of the target area in which the contrast in the image is proportional to the magnitude of

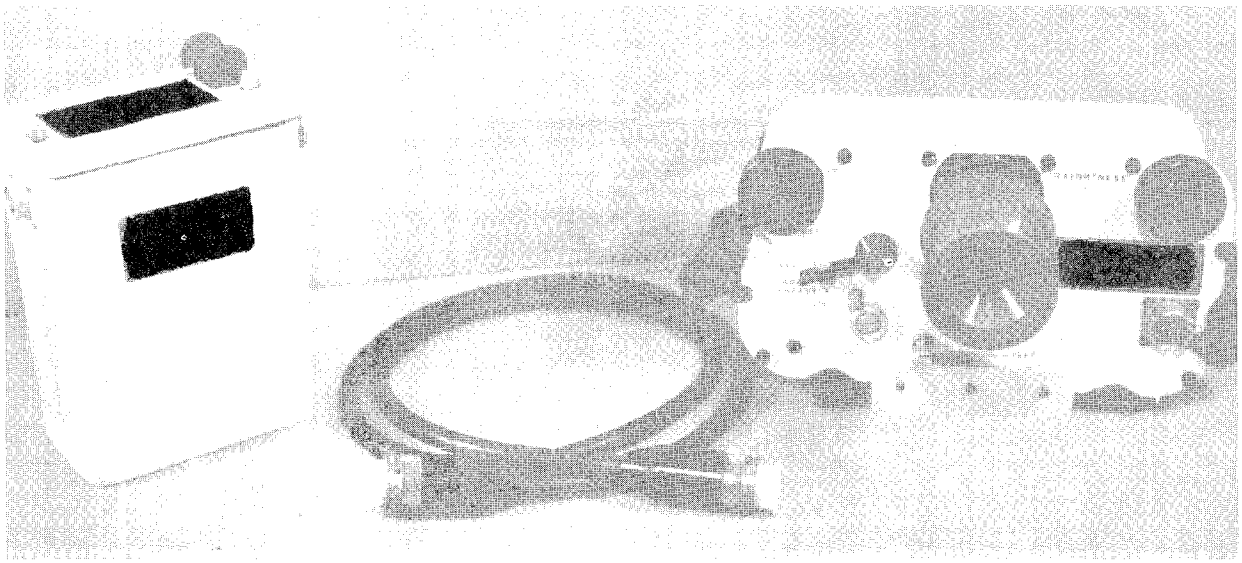

FIGURE 2. - Infrared scanner.

and the Delaware dump. Thermal anomalies were found on the Plymouth, Eastside, and Delaware dumps. The investigations at each site are described in the following summary.

Larksville Dump

The Larksville dump is covered with a blanket of broken rock and dirt. Reportedly, while this dump was being used for deposition of trash, fire broke out on the surface on two separate occasions. Each time the fire was extinquished by the local fire company.

This dump was traversed and crisscrossed several times with the infrared scanner and was examined with the instrument from three remote observation points to insure adequate examination. No thermal anomalies were detected.

Swoyersville Dump

Dumping of debris at the Swoyersville dump was terminated 4 days before the infrared measurements were taken. Work was still in progress to cover the dump with dirt, and about 2 feet of a planned 6 feet of compacted soil cover was in place.

On one occasion, while the dump was still receiving trash, a temperature buildup is reported to have occurred. However, the material involved was scattered and work in the dump was continued.

This dump was examined with the infrared scanner from two different locations. No thermal anomalies were detected on the surface. If temperature buildup was occurring in this dump, the heat had not had sufficient time to reach the surface.

West Wyoming Dump

At the time of the investigation, the West Wyoming dump had been completed for about 5 to 6 weeks and was covered with 5 feet of dirt plus 2 feet of red dog (a total of 7 feet of cover).

No abnormal temperatures were detected on the surface of this dump.

Edwardsville Dump

When examined, the Edwardsville dump (also known as the Larksville No. 2) was being filled with alternating layers of 15 feet of trash and 2 feet of dirt. Reportedly, a small fire had broken out on the surface of the dump on one occasion but had been extinguished.

No thermal anomalies were detected on the surface of the Edwardsville dump.

Figure 3 is a photograph of the Plymouth dump, and figure 4 is a photograph of the thermal anomaly as displayed on the scanner. Because the scanner's field of view was too small to include the entire anomaly (from any practical point of observation), figure 4 is a composite of two different pictures. In order that the two figures may be referenced to each other, the man in figure 3 is standing by the tree limb that creates the open air passage into the dump. In figure 4, the open air passage is in the large bright spot near the center of the anomaly.

Six weeks after the infrared fieldwork was completed, a trench 8 feet wide and 4 feet deep was dug along the axis of the thermal anomaly to verify the existence of a subsurface temperature buildup (fig. 5). Temperatures encountered were 220° F or more. The carbon monoxide content of gases emitted from vents in the trench exceeded the maximum range (0.1 percent) of the measuring device.

Eastside Dump

At the time of the investigation, the Eastside dump was still being filled with debris and was only partially covered with dirt and rock. A small thermal anomaly that existed on the surface of the dump was observed with the infrared scanner. Near the center of the anomaly, at a depth of 12 inches in the dump, the temperature was 112° F. At the same depth outside but adjacent to the anomaly, the temperature was 70° F. No carbon monoxide was detected at this site.

Delaware Dump

At the Delaware dump (fig. 6), approximately 80,000 cubic yards of debris had been deposited and covered with 6 feet of red dog and spoil bank material. This dump differed from the other sites investigated in that thin wisps of smoke could occasionally be detected to aid in locating an area of high surface temperature. By use of the infrared scanner, a hot spot was observed which included the smoke-emitting area. This hot spot or area of anomalous temperature (fig. 7) was most easily observed on the slope or face of the dump. It tended to be wishbone in shape, and was about 15 feet wide and about 30 feet high. No attempt was made to measure temperatures in this area. The anomaly was also detected on the top surface of the dump. Here, the surface was broken by a thin fracture that had formed across the anomaly. Smoke was seeping through this fracture and escaping into the atmosphere. Temperature measurements taken at a depth of 12 inches in this fracture ranged from 170° F in the center of the anomaly to 74° F outside the anomaly.

It should be noted that 6 days after the infrared investigation at this site, open fire started on the Delaware dump at the site of the thermal anomaly detected by the infrared scanner. The fire was extinguished by digging out that portion of the dump (fig. 8).

FIGURE 5. - Trench in Plymouth dump.

FIGURE 8. - Delaware dump during work to extinguish fire.

CONCLUSIONS

Results of the investigation indicate that the handheld infrared scanner can be used to detect combustion or temperature buildup in a waste dump. Thermal anomalies were detected on the surface of three dumps, which indicated subsurface temperature buildup or combustion. In one of these dumps (Delaware) combustion was present. Six days after the investigation, open fire started at the site indicated by the infrared scanner; temperature and carbon monoxide measurements in a second site (Plymouth) indicated either real or potential combustion. Temperature measurements verified results of the surveys with the scanner.