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Remote Identification of Liquids in a Dielectric Container Using Millimeter Waves. 2. Linear Scanning[1]

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Abstract—The results of experimental studies showing the applicability of short-range radar in the millimeter wavelength range for remote identification of explosive liquids in closed dielectric containers are presented. This study presents radiometric study of hazardous liquids based on an example of gasolines and diesel fuels. It has been shown experimentally that radiometric studies allow remote studies and object identification at distances of up to several meters. The variety of physical and chemical properties of liquid fuels does not allow their identification using the measurement results of only the permittivity and loss tangent from one measurement in one frequency range. The use of a thermal portrait of liquid fuels in closed dielectric containers for their identification is more illustrative and informative. The dependence of the spatial temperature portrait of the container with liquid on the polarization of the received signal is experimentally shown. The use of different polarizations of the received signal and the difference in the spatial temperature portraits of the liquid in the container provide additional information in order to increase the probability of correct identification of the liquid. Thermal portraits obtained with linear scanning for gasolines of different manufacturers differ more strongly, in comparison with thermal portraits of diesel fuels. Due to the modification of the measuring system, the total time for scanning and obtaining the output experimental data is 42 s. The standard deviation of the obtained experimental data did not exceed 3.6%.

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1. INTRODUCTION

It was shown in [1] that the specific features of the short-range radar make it possible to tackle problems fundamentally unsolvable by means of long-range radar and infrared techniques, namely the remote measurement of the temperature distribution of objects and investigation of their internal structure, including liquids in closed dielectric containers (tare). The principle possibility of remote detection of explosive and flammable liquids in a dielectric container and their difference from non-hazardous liquids, for example, mineral water is also shown.

Detailed studies of hazardous liquids based on the example of flammable liquids - gasolines and diesel fuels have been carried out in this study. The results of studies of other highly flammable liquids (for example, alcohols, solvents) is not part of this work.

Determination of the fuel composition, its compliance with National standards or specifications is a labor-intensive and technically complex task. In the present work, the possibility of using a remote short-range radar method not only to identify fuels, but also to determine the differences of same type fuels of several manufacturers, is considered.

The choice of gasoline and diesel fuels (DFs) as research objects is due to their great variety, as well as the need to experimentally test the short-range radar technique in the millimeter wavelength range with the aim of using it for remote detection of not only the liquid in the closed dielectric containers, but also to specific types of fuel.

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