NASA TECH BRIEF

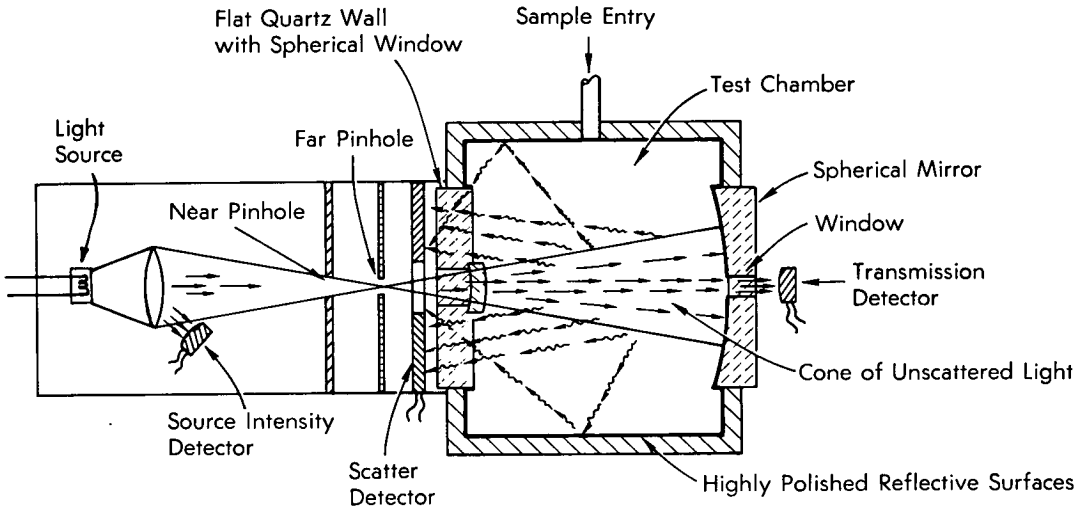
Ames Research Center

Particle Detection by a Light-Scattering Technique

An improved instrument measures the concentration of small particles in an aqueous medium in terms of the amount of light scattered and the degree to which light transmission is attenuated. Sensitivity to small particles is optimized because both scattered and transmitted illumination levels are detected by photodiodes. The light source, the optical system, and the test chamber are integrated into a single mechanical unit with an internal volume of 1.0 cm^3 and external dimensions 3.8 x 2.5 x 1.9 cm; the walls of the test chamber are highly polished.

The light source indicated in the figure is a small 5-V tungsten filament bulb mounted in a blackened lamp housing equipped with a condenser. Light from the lamp passes through two knife-edge pinholes in series, the one at the near face and the other at the far face of a second blackbody housing coincident with the focused image of the tungsten filament.

A spherical quartz window allows a divergent light beam to pass into the test chamber and through the medium contained in it to a concave spherical mirror at the far end. When no particles are present in the test chamber, light is reflected directly back through the quartz window and the pinholes, and is removed from the test cell. However, if there are any particles in the test chamber, the light scattered by the particles is reflected many times by the polished walls of the test cell and eventually caused to pass through the flat quartz wall at the near end of the chamber, where it impinges on the annular photodiode used as a scatter detector.



As in all similar particle detecting devices, the output signal of the diode is a measure of particle density; however the multiple internal reflections which occur within the test chamber in this improved instrument increase the sensitivity of detection. A sample of the

(continued overleaf)

light transmitted by the contents of the test cell is measured by a photodiode behind a small clear window in the center of the spherical mirror. A third photodiode located adjacent to the light source acts as a sensing element for an electronic servo loop which maintains constant illumination and provides a reference level for quantitative measurements of scatter and transmission.

Notes:

1. This instrument was proposed for use as a life-detecting device on a Mars-landing space vehicle. For this purpose, a stirring device is to be used to maintain soil samples in suspension in nutrient media. An increase in turbidity would then indicate the presence of microbial life. The same optical arrangement should be useful on earth for studies of turbidity and the light-scattering characteristics of various liquids.
2. Reflections at the quartz/water interface are held to a low level (about 0.2% in each direction) and remain in the transmitted light cone because the light strikes the interface perpendicularly.
3. Requests for further information may be directed to:

   Technology Utilization Officer
   Ames Research Center
   Moffett Field, California 94035
   Reference: TSP 72-10160

Patent status:

No patent action is contemplated by NASA.

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