1972

B72-10026

NASA TECH BRIEF

Ames Research Center

Rising-Plate Rheometer

The problem:

To measure the degree of structure of hazardous, hygroscopic, and reactive cryogenic propellant gels.

The solution:

Weigh the cone of propellant gel which remains on a disc that has been slowly pulled out of the gel.

How it's done:

Studies of gelled cryogenic propellants require the measurement of static properties such as degree of structure or structure index. Ordinarily, the structure index is measured by determining the maximum weight of a sphere that can be supported by the gel. However, this technique requires some manual operations that may be hazardous to the operator and usually result in excessive exposure of reactive or hygroscopic propellants to the atmosphere. A new technique was developed to eliminate hazards of handling the propellants and to permit determination of the structure index of a gel by remote control.

A thin metal disc is deeply immersed in the gel in a horizontal position. After a period of time, governed largely by the character of the gel, the disc is very slowly withdrawn; an inverted cone of propellant remains on the disc. The angle of repose, that is, the angle between the horizontal disc and the side of the cone, is related to the degree of structure of the gel; the greater the degree of structure, the greater the angle of repose.

The angle of repose does not have to be measured directly because the mass of propellant which remains on the disc is an indirect measure of the angle of repose, for as the degree of gel structure increases, the mass of propellant remaining on the disc increases. This mass, in turn, provides a direct measurement of the gel structure under zero-shear conditions.

Measurement of the mass of gel on the disc is made by a strain gage that is situated outside of the container with the gel propellant; thus, there is no need for the operator to be in the vicinity of the propellant. Moreover, since the disc need not be very large, the measurement can be made on small quantities of material and often can be included with other measuring devices in the container holding the propellant.

The results of experiments indicate that minor differences in rate of rise of the disc, disc shape, disc area, and disc tilt do not affect results significantly. For comparison of different propellant compositions, however, it is necessary to take into account their densities; this is done by calculating the volume of the cone of the propellant from the measured mass of the propellant in the cone. The structure index of the propellant gel is then determined from a graph of the index versus cone volume.

The following table shows correlation of the structure index obtained by the new technique and the sphere method; the data were obtained on gels prepared from vacuum pump oil and a silica gelling agent.

Gellant, wt-%	Structure Index, N/m^2		Volume, ml
	Sphere Method	New Method	
2.5	20.0	25.0	1.88
3.0	70.0	70.0	5.28
3.5	170.0	150.0	11.31
4.0	240.0	190.0	14.33

(continued overleaf)

These data were used to prepare the graph of structure index versus cone volume discussed in a previous paragraph.

Note:

No additional information is available. Specific questions, however, may be directed to:

Technology Utilization Officer
Ames Research Center
Moffett Field, California 94035
Reference: B72-10026

Patent status:

No patent action is contemplated by NASA.

Source: R. H. Globus and
E. M. Vander Wall of
Aerojet Liquid Rocket Company
under contract to
Ames Research Center
(ARC-10524)