Rocket Research Corp.

From the thick, black, dough-like gel of the waste-based Monex W . . .

FUEL TECHNOLOGY

Waste Makes Haste

Rocket fuel made of human waste can be a source of emergency power and a spacefaring garbage disposal.

by Jonathan Eberhart

Getting rid of bodily wastes during long space flights is a problem that is already worrying space researchers, even though the first such mission may be a decade or more in the future. On a year-long round-trip flyby of Mars, for example, it has been estimated that a three-man crew would produce almost a ton of waste, not even including urine (which would probably be reprocessed for drinking and washing).

A bizarre possible solution is now being investigated both by industry and by the Federal space agency, at its Langley Research Center in Hampton, Va. It involves whipping the wastes in with some other ingredients to produce the most unusual rocket fuel since Aerojet-General proposed grinding up lunar rocks for return trips to earth.

The idea arose when Rocket Research Corp. in Seattle was experimenting with a propellant it had developed in which a major ingredient was water. Since human feces are some 70 percent water, some company scientists reasoned that these wastes might be usable in a propellant, either as a disposal system or as a weight-saving source of fuel, since less weight of other ingredients would thus need to be carried aboard a space vehicle.

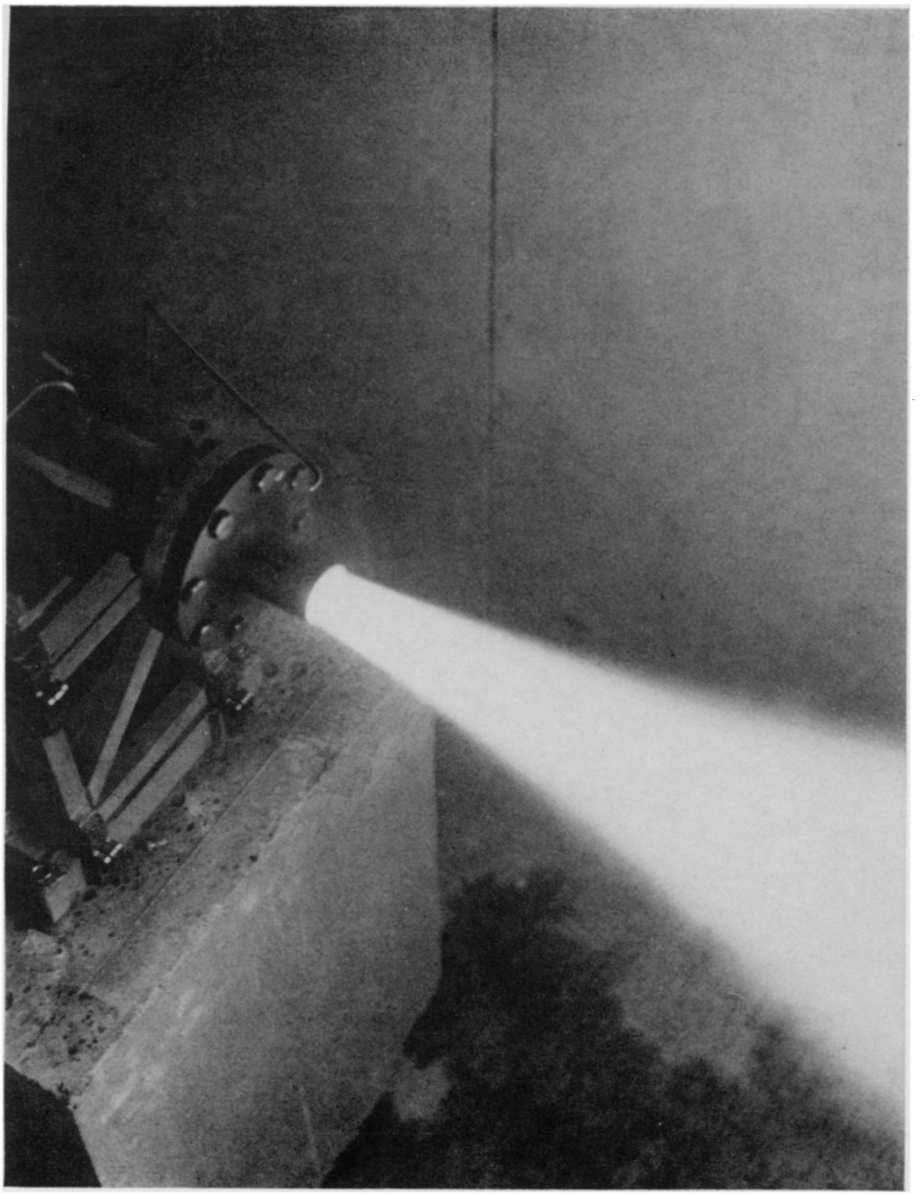
The fuel, which Rocket Research calls Monex W, has a simple recipe: the four ingredients—carbon, ammonium nitrate, aluminum and the waste material—are just blended together and they're ready to go. "You could use a Mixmaster if you wanted to," says James Jones of the National Aeronautics and Space Administration. The result is a thick black, dough-like gel which can be pumped into a fuel tank as soon as it is mixed. One concern was that the heavy carbon and aluminum particles might settle out of the mix after a while, but apparently the material holds its form well. Rocket Research and NASA agree that Monex W has little or no odor, but both believe that a largely automatic mixing system would be needed to minimize the psychological problem."

The propellant's specific impulse, a sort of miles-per-gallon figure for rockets equal to the amount of thrust per pound of fuel consumed, is presently about 185, says NASA, which is about 85 percent of the maximum that is theoretically possible. Most metal-containing solid propellants operate at about 93 percent of their theoretical maximum, and the investigators believe that Monex W will approach that figure as the most efficient balance of ingredients is reached.

Since it's a gel, Monex W can also be used as a liquid fuel, injected through a nozzle and ignited in a combustion chamber. "It's performance is less than most current liquid propellants," says Dr. Carl David Good of Rocket Research, "but having the waste on board means that less propellant weight has to be carried to produce the same amount of total impulse."

Since it is limited by the amount of available waste, Monex W would not be used to provide large amounts of thrust, but would probably be used to help a spacecraft change position or to nudge a long-life space station occasionally to keep it up in orbit. There have been 13 test firings at NASA of Monex W-fueled rocket motors, plus "more than 10" at Rocket Research, and the maximum thrust of any of them was 250 pounds. This is only a tenth the power of the pitch control motor in the Apollo spacecraft launch escape tower.

Unfortunately, the ingredient mixture that contains the most waste is not the one that is the most efficient propellant, so the fuel mix would be different in a waste disposal system than in a rocket used primarily for thrust. Above a certain percentage of waste, in fact, the stuff just won't burn at all. Both NASA and the company has so far found that the most waste the mixture will stand is just under 40 percent, although the researchers think that playing around



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. . . 250 pounds of thrust has been produced in a test firing series.

with the other ingredients should raise this amount, perhaps to as much as half the total propellant weight.

The most fascinating notion suggested by Monex W and the water-based Monex A, however, lies much further in the future than waste-consuming garbage rockets. The Monex researchers agree that virtually "anything organic" can be used in the propellant; so imagine a rocket, probably for emergency use, that could burn seat covers, safety belts, flight manuals, pencils, padding, even space suits. Given the proper materials, all that would be needed is a pulverizer to grind the materials down into particles small enough to flow through the rocket's injector nozzle.

NASA has already thought of developing a polyethylene food wrapper that would convert easily into an injectable form, though it hasn't gotten any further than a thought. Rocket Research says, though no test firings have been made, that the waste portion of Monex W could include towels, paper and even waste food.

Other possibilities might include a floating water purification system, with a rocket motor pointing straight up from a barge, or a combination garbage dump and power station. Neither NASA nor the company is considering such ideas, however, and both developments would depend on the cost of the other propellant ingredients being low enough to compete with say, water purification (by filtration) and electricity produced from nuclear energy.

In the meantime, Rocket Research has a study contract from NASA Langley that ends with a final report in November.