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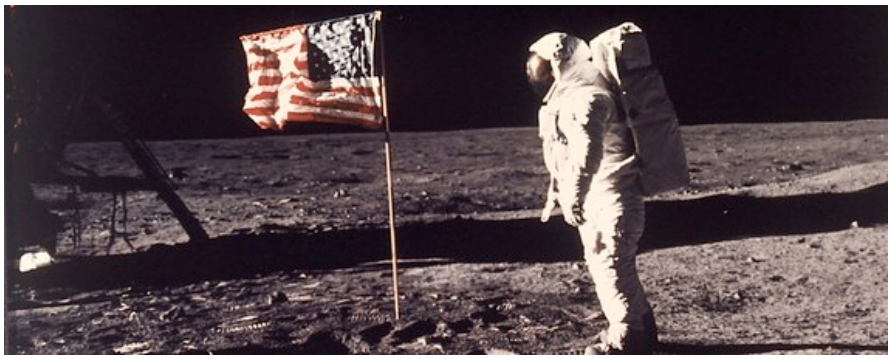
One Small Step for Man, One Giant Mess in the Spacecraft

NASA Plans Another Lunar Landing, but Oh! That Nasty Moon Dust

By STEPHANIE SIMON



Associated Press/NASA

Astronaut Edwin "Buzz" Aldrin beside the U.S. flag on the moon.

NASA is again shooting for the moon, but before a manned mission can get off the ground, scientists must solve a vexing technological challenge: dust.

As the Apollo 11 astronauts found out when they walked onto the moon 40 years ago Monday, lunar dust is downright treacherous. To the naked eye, it looks powdery, almost fluffy. But each particle is jagged. Dust scratched the astronauts' visors, ground into the joints of their spacesuits, clogged their equipment, and -- after they inadvertently tracked it into their living quarters -- lodged in their lungs.

"It gets into everything," says Jeff Hanley, who manages NASA's next-generation rocket program. "Dust is one of the biggest challenges we face."

And yet now, with NASA preparing to set up a lunar outpost by 2020, researchers are clamoring for the stuff. Some need it to conduct medical and equipment tests. Other scientists hope to study the lunar soil to see if it can be turned into bricks or smoothed into roads. A still more ambitious goal:

Preparing for a new mission, NASA doesn't want jagged moon dust to get in the way like it did 40 years ago. WSJ's Stephanie Simon speaks to an engineer who'll make up to 500 tons of the simulated stuff with a 40,000-degree furnace so NASA can study the pesky powder.

into roads. A still more ambitious goal: figuring out how to use solar energy to extract the oxygen molecules bound up in the soil.

Add all these research demands together, and NASA will need 500 tons of the heavenly dust, maybe more. And that is a problem. Over several missions, the Apollo astronauts brought back a grand total of 227 pounds of lunar dust and soil. Those samples, said to smell ever so faintly like gunpowder, are stored in a vault at the Johnson Space Center in Houston. To get access, scientists must petition a NASA committee on extraterrestrial materials. If they are approved, they are lucky to get a sample the size of a couple of aspirins. One eminent geologist once got a sample that consisted of six specks.

"It's a national treasure," explains Carole McLemore, a NASA project manager. "So many people need moon dirt, and there's just not enough to go around."

NASA's solution? Fake it.

Ms. McLemore helps run a $19 million project to fabricate what NASA calls "high-fidelity" lunar simulant. The process can be as complicated as, well, rocket science.

That is because moon dust is not at all like its earthly cousin. The moon is under constant bombardment by micrometeorites, which smash into the surface at tremendous speed, generating an intense heat that fuses dust particles together and melts the component minerals into bits of glass.

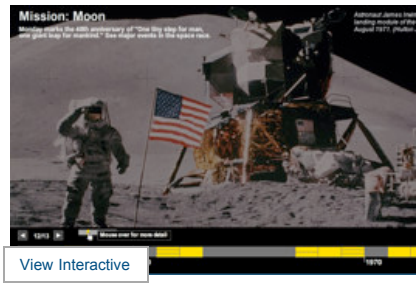
When Neil Armstrong and Buzz Aldrin planted the American flag on the moon on July 20, 1969, dust almost ruined the photo op. Compacted dust made the particles interlock like a jigsaw puzzle, forming a rock-hard layer that the flagpole could barely penetrate.

Efforts to re-create moon dust are not unprecedented. In 1993, Texas geologist James Carter developed a simulation of lunar soil, called JSC-1, by milling volcanic cinders collected from the Merriam Crater near Flagstaff, Ariz. The mineral content was a good match -- and JSC-1 was widely used in NASA research -- but the particles didn't have the quantity of jagged edges that make real moon dust such a menace. Mr. Carter refined the grinding process in 2007 and is now making a version with a bit more of a bite.

He likes to take the ersatz lunar dust to grade schools to show kids. "They come up and want my autograph," he says.

But JSC-1 was designed to resemble the chemical composition of the basalt rock in the lunar valleys -- the dark patches visible on the moon. The next lunar landings are likely to be in the white patches, known as the highlands. Those are very different in chemical composition and contain more fragments melted by the heat of meteor

Mission: Moon



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impact.

So NASA and the U.S. Geological Survey teamed up to scour the globe -- or, actually, the scientific literature on composition of rocks around the globe -- for a spot that mimics the lunar highlands. In 2006, they found it around a working platinum mine in Nye, Mont., near Yellowstone National Park.

"It's as good as it gets," says Doug Stoeser, co-chief of the federal lunar simulant project.

Every year, Mr. Stoeser supervises a field trip to the Stillwater Mine to collect up to 12 tons of rocks and mine waste. He then has it trucked to Denver, where it is pulverized into smooth, rounded grains. Still, the resulting particles are nothing like the irregular glassy ones found on the moon.

Next stop for the stuff: a small engineering firm with a bare-bones office in Boulder, Colo. called Zybek Advanced Products, Inc. A few years ago, in a bid to reduce the days-long processing time for making certain forms of fiberglass, owner Michael Weinstein invented a plasma furnace capable of burning incredibly hot.

The furnace wheezes like an aging jet engine and looks alarmingly Rube Goldbergesque -- all tubes and wires and banged-up sheets of metal. But with two blindingly white, criss-crossing plasma rays, it can concentrate one megawatt of energy on a surface the size of a dinner plate.

All that energy produces an astounding heat, topping 30,000 degrees Fahrenheit. By comparison, the surface of the sun is thought to be about 10,000 degrees Fahrenheit. "It can pretty much melt anything," says Mr. Weinstein of his furnace.

Mix the right blend of minerals and crumbled rock, zap it in the furnace for 1.5 seconds and -- voila! A red-hot molten mess shot through with glassy globules known as agglutinate, common on the moon but rare on Earth. When it cools, Mr. Weinstein pummels it in a special mill that rips apart the particles with violent sonic booms, turning it into jagged-edged moon dust that he sells to NASA and independent researchers for about $35,000 a ton.

Lunar curator Judy Allton, who works at the Johnson Space Center, says she welcomes the innovation of the moon-dust simulant. Yet there is a wistful note in her voice as she talks about the decades she spent painstakingly sifting through the genuine lunar samples brought back by Apollo astronauts.

"It was really gorgeous," she says. "Like jewels."

Write to Stephanie Simon at stephanie.simon@wsj.com

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