Oil spill model born of Ixtoc I

History's largest oil spill — which began with the June 3, 1979, Ixtoc I exploratory well blowout — was a floating laboratory that stretched from 50 miles offshore of Ciudad del Carmen, Mexico, north to the Texas coast. Scientists still are gathering the fruits of work conducted on that spill (SN: 10/25/80, p. 267; 5/2/81, p. 285). The latest example, which is described in the August ENVIRONMENTAL SCIENCE & TECHNOLOGY, is an oil-spill computer model with "powerful predictive capabilities."

In recent years, scientists have developed several major computer programs that attempt to predict how spilled oil will weather (for example, by evaporation, dissolution or degradation by microbes). But these models are based more on fundamental principles of chemistry and test-tube experiments than on field work. By contrast, the newest model is "rooted firmly in analytical measurements on samples from an actual major spill," report its developers, Paul D. Boehm and David L. Fiest of Energy Resources Company Incorporated in Cambridge, Mass., and Donald Mackay and Sally Paterson of the University of Toronto.

The samples were collected by two ships, the *Researcher* and the *Pierce,* that were in the vicinity of the Ixtoc blowout between Sept. 14 and 23, 1979. Ship crews collected samples of mousse (the orange-brown water-in-oil emulsions), ultra-thin oil sheen, suspended oil droplets and water along a 100-kilometer transect radiating from the blowout in the direction of oil movement. The samples then were analyzed by a procedure that involves capillary gas chromatography (using a gas to force a sample through a long, thin column that is packed with special material to separate the sample's components) to determine the types and amounts of hydrocarbons (hydrogen- and carbon-containing molecules) in the spilled oil.

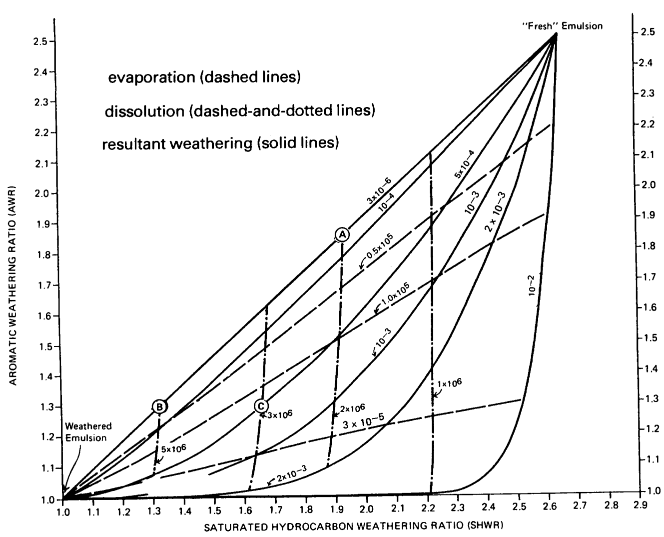
For purposes of developing a mathematical model, Boehm and colleagues next used the resulting data to determine two key ratios for the collected samples. One ratio, the aromatic weathering ratio (AWR), represents, for a given sample, the sum of heavy and light aromatics (ringed hydrocarbons) over the sum of only the heavy aromatics (those containing more than 2 rings). The other ratio, the saturated hydrocarbon weathering ratio (SHWR), represents the sum of both light and heavy alkanes (hydrocarbon chains) over the sum of only the heavy alkanes (those containing 17 to 25 carbons). These ratios are plotted, AWR versus SHWR, for each sample.

The resulting graph (see below) is a model of early weathering — degradation that occurs within the first two weeks of the spill. The light hydrocarbons weather more quickly, Boehm explains; so on the graph, a spill starts at the upper, right-hand point ("fresh" emulsion) and moves to the lower, left-hand origin, as the "disappearing" lighter hydrocarbons cause the mathematical ratios to become smaller.

In the event of a future oil spill, researchers could plug time-since-the-spill, temperature, surface area of spill and mathematical constants for the rates of evaporation and dissolution into formulas to predict where on the graph the oil will be (and therefore its composition) when the spill hits the coast. This information in turn could be used, for example, to give clean-up crews an idea of the toxicity of the coast-hitting spills (it is known that lighter aromatics are the most toxic components of oil).

While several more parameters, such as the rate of photochemical oil degradation, eventually must be worked into the computer program, Boehm says that for an Ixtoc-like spill (one involving relatively calm seas and little microbial degradation), the model now "is ready to use."

—*L. Garmon*



Boehm, et al./ES&T

Using this model, a spill sample of 5,000 moles (a unit of quantity) loses 1,039 moles by evaporation and 2 moles by dissolution after 30 hours (A). After 72 hours (B), 1,867 moles have evaporated and 4 moles have dissolved. Point C, a sample pushed subsurface, perhaps by waves, was more dissolved than evaporated (dissolution preferentially depletes aromatics).

The Viking Fund: Keeping the Marslink

The Viking 1 landing craft reached the surface of Mars on July 20, 1976, designed to operate for three months and with scientists hoping that it might last as long as a year. More than six years later, the doughty device is still ticking away, snapping pictures of the terrain and monitoring the Martian weather. (Three other Viking craft — a second lander and two orbiters — have long since ceased functioning.) Its cameras have photographed every square centimeter of their surroundings many times over, and the weather varies little, except for the occasional duststorms. Yet its longevity has made it a unique tool, capable of recording changes that, though subtle, are amassing an ever-growing data base on the meteorology of another world.

Nearly three years ago, the lander's potential for a long lifetime prompted an unusual response from within the growing number of grassroots space-program enthusiasts concerned about the declining state of NASA's planetary explorations. The lander by then had been placed in what was colloquially referred to as its "eternal mode," designed to operate, almost unattended, through the end of 1994. With the space agency's planetary research funds dropping at the same time, California aerospace engineer Stan Kent inaugurated the Viking Fund — not a club, not a lobbying organization, but a way of soliciting private donations that could be passed on to NASA itself as evidence of the most direct kind of public support. It took some legal shuffling to find a way by which the federal government could accept public monies for other than an unrestricted purpose. But on Jan. 7, 1981, while pointing out that the fund would not make a life-or-death difference to the lander's continued operation, NASA accepted the fund's contribution of $60,000, representing some 10,000 individual donors. Assigned to help support the tracking-network activities that would keep the lander's data coming, the money freed other NASA funds to aid Viking's continuing meteorological analyses, among other activities.

Now the Viking Fund, which has grown to represent nearly 15,000 contributors, is making another donation — or donations. This time, about $5,000 is going to NASA, while another $25,000 is being used in other ways to benefit the continued gathering and dissemination of the lander's data. At the University of Washington, for example, James Tillman and colleagues have been working to resolve ambiguities in some of the lander's wind-direction data. In addition, a microprocessor donated by Intel Corp. is being used to help speed up the transfer of data from JPL to the university for processing. Additional contributions, says Kent, are planned.

—*J. Eberhart*