ChE views and opinions

On the treadmill of the windfall of windmill research

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The latest ploy in the university fund raising game is to develop pollution free power sources. However, individual proposals are no longer chic and interdisciplinary research is going out of vogue. Instead, the "bureaucrats with the bills" are now looking for interuniversity proposals and for regional solutions to problems.

Recently our dean issued an indirect directive calling for interdisciplinary research proposals concerned with a number of specific types of pollution free power sources; and the list included windmills. In an attempt to get "one-up," I decided to see if it was possible to develop an interuniversity research effort. Thus, I asked **Chemical Engineering Education** to perform a public service by publishing my list of proposed topics for windmill research. This list was put together without any thought, but if any of you are interested perhaps we can submit a joint proposal.

1. **Visual Pollution of Windmills**—According to a motivational study undertaken by the Santa Barbara Institute for the Bewildered (and sponsored by the National Science Foundation, Grant No. G6438), one of the major reasons the use of windmills fell into disrepute was the fact that they are most unsightly. (The other major reason was that Don Quixote has opposed to all products of the military-industrial complex). A statistical analysis of the data revealed that the visual pollution caused by windmills was even worse than that due to electrical transmission lines. Hence, in order to create a resurgence of windmills we need to develop the technology for installing them underground.

2. **Thermal Pollution of the Air**—In order to meet the power demand in 1984 of 13.628 x 10^{56} joule microseconds it will be necessary to build 13.628 x 10^{22} windmills. While the heat generated by friction in each windmill is not very great, it has been estimated that the total heat generated by all these additional windmills will be sufficient to raise the ambient temperature throughout the world by 8.624°F. Again, at first glance, this does not seem to be a significant factor, but in addition to completely melting the polar ice cap in 13.628 years (which would lead to complete flooding of all the world's land mass), it would also raise the average body temperature 1.8329° and therefore greatly increase the world supply of hot blooded males. Hence, estimates indicate that the population would increase 2.764 fold in the 13.628 years remaining before complete disaster, and man would be guilty of even greater crimes against humanity. To avoid this eco-catastrophe we need to develop the technology of water-cooling the windmills. Alternately we could study the use of nuclear energy to power the windmills, rather than wind, because less heat is generated by friction with this approach.

3. **Orbital Stability of the Earth.**—It is well known that all windmills in the northern hemisphere rotate clockwise while all those in the southern hemisphere rotate counterclockwise. However, since most of the industrial nations are located north of the equator, the tremendous excess of windmills which will exist there can be expected to cause the earth's orbit to precess. Calculations show that on Thursday, April 24, 2073 at 4:23 P.M. the town of Slobbering Jaw, Minnesota will be coincident with the North Pole of the earth and that the polar cap will completely cover the U.S. Hence we need to establish a research team to study real estate prices in South America.

4. **Preventing the Eco-Disaster**—After reading the predictions of all the leading politicians, particularly those in lesser offices than they aspire to, it is readily apparent that the world is headed toward an eco-disaster which only the leadership of those politicians, and lots of money, can avert. Fortunately, I have a research idea, which if it receives the rock bottom funding of $1.365 billion per day, will prevent this eco-tragedy. The idea is based on a little publicized observation of Dr. Hollering Bascombe, Harvard, Class of 03, who noted that there is a geological cliff formation in South Hadley, Mass. which produces louder echoes than anywhere else in the world. Hence I propose that we build a technical school near this spot— The South Hadley Institute of Technology, and we will admit as students all of those great, heart-warming, intelligent, idealistic . . . kids who attended the Woodstock Rock Festival. Next, we will arrange a large number of windmills in a parabolic arc facing the cliffs, so that the school is at the focus of the parabola. The windmills will be operated in a reverse fashion so that they blow air toward the cliffs. Now, if we get all the Woodstock kids, who shouted to the heavens for hours for the rain to stop, to yell the initials of the university— S.—.—.—. at the top of their lungs until they are **hoarse**, their cry will echo off the cliffs, be carried back to the cliffs by wind from the parabolic reflector of windmills, and thus reverbrate forever. Moreover, the country will finally wake-up and heat the cry of ECHO-HOARSE-S — — —.

from our READERS

Sir: The point raised by Dr. Davidson in the Spring issue, on the proper handling of variable heat capacity terms, is well taken. Dr. Davidson's arguments can, however, be presented in a much simpler manner.

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propounded philosophies of model building requires a certain amount of maturity on the part of the students as well as teacher. The material can certainly be taught in abbreviated form as an undergraduate senior year elective, as the authors themselves do, but it would require a great deal of judgment and experience as well as enthusiasm on their part. Fortunately, the University of Arizona has a second-year graduate course in the area of process simulation, following first-year courses in transport phenomena and process dynamics and control; this text is quite successfully used in this graduate course. The material in this book is as important, or more so, to the terminating MS candidate as to the PhD student. Three semesters are normally required for such MS students and it should not be difficult to enroll them in the course during their final term.

Finally, this book should be on the shelf of every practicing engineer who is even remotely connected with the art of process simulation or must interact with those who are. Some books, by their language and format, widen the gap between the academic establishment and practicing engineers in industry. This book moves the two groups closer together.

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LETTERS (cont'd from p. 103)

Consider a gas filling an originally empty tank. If we assume the gas in the tank to be well mixed, the total internal energy of the gas is given, at any instant, by

$$U_{total} = m\,u \qquad [1]$$

where m is the total mass, and u the internal energy per unit mass. The internal energy per unit mass may be expressed in the following manner:

$$u - u_o = \int_{T_o}^{T} \left(\frac{\partial u}{\partial T}\right)_v d\,T = \int_{T_o}^{T} c_v\, d\,T \qquad [2]$$

where T_0 is a reference temperature and c_v the heat capacity per unit mass, at constant volume. Then

$$U_{total} = m\,[\,u_o + \int_{T_o}^{T} c_v\, dT\,] \qquad [3]$$

Differentiating with respect to time

$$\dot{U}_{total} = \dot{m}\,u + m\frac{d}{dt}\int_{T_o}^{T} c_v\, d\,T$$

where

$$\frac{d}{dt}\int_{T_o}^{T} c_v\, d\,T = \left(\frac{d}{dT}\int_{T_o}^{T} c_v\, d\,T\right)\frac{dT}{dt} = c_v(T)\,\frac{dT}{dt}$$

by Leibnitz's rule. Hence we finally obtain

$$\dot{U}_{total} = \dot{m}\,u + m\,c_v(T)\,\frac{dT}{dt} \qquad [4]$$

It is thus incorrect to express U total in the form

$$\dot{U}_{total} = \frac{d}{dt}\{\,m\,c_v(T)\,(T-T_o)\,\} \qquad [5]$$

as noted by Dr. Davidson. In the case where $c_v \neq c_v$ (T), eqs. 4 and 5 are equivalent.

University of Florida
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ChE News

CACHE Committee Established by National Academy of Engineering . . . Goal Is to Accelerate Integration of Digital Computation into ChE Education

A panel of chemical engineering educators called the CACHE (Computer Aids for Chemical Engineering Education) Committee has been established by the National Academy of Engineering's Commission on Education. The purpose of the committee is to coordinate and encourage the development of computing systems for use in chemical engineering education. The National Science Foundation has provided a grant to support the activities of the CACHE Committee for a two-year period.

The 17 members of the committee are drawn from universities throughout the United States and Canada. Each member is actively concerned with the use of computers in chemical engineering and many of them have been at the forefront of the rapid developments in chemical engineering computing that have taken place during the past decade.

CACHE officers elected at a recent meeting in Ann Arbor are: W. D. Seider (Pennsylvania), chairman; L. B. Evans (MIT), vice chairman; and A. W. Westerberg (Florida), secretary. Other members of the committee are: B. Carnahan (Michigan), J. H. Christensen (Oklahoma), E. Elzy (Oregon State), E. A. Grens (California at Berkeley), E. J. Henley (Houston), R. R. Hughes (Wisconsin), R. V. Jelinek (Syracuse), A. I. Johnson (McMaster), R. L. Motard (Houston) M. J. Reilly (Carnegie-Mellon), J. D. Seader (Utah), P. T. Shannon (Dartmouth), R. E. C. Weaver (Tulane), and I. Zwiebel (Worcester Polytechnic).

The principal goal of the committee will be to accelerate the integration of digital computation into the chemical engineering curriculum by promoting inter-university cooperation in preparation of new courses, teaching aids, and computing systems.

A major stumbling block to widespread use of the computer in engineering education has been the difficulty in transferring computer programs developed at one institution for use at another. Incompatibilities in computer system conventions, data formats, and documentation have been responsible for duplication of effort at different schools. CACHE has established a Standards Subcommittee to devise mechanisms for facilitating easier inter-university interchange of computer programs.