Letters

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The Growth of Biological Nanotechnology

As a molecular biologist who performs DNA-based nanotechnological research, I found the December issue of *CEP* ("Biological Nanotechnology," pp. 33–51) extremely interesting. Biological nanotechnology is a fast-growing field that has enormous potential in a variety of scientific disciplines.

The design and construction of artificial DNA, RNA, protein, nucleic acid-protein complexes, nucleic acid-ligand complexes, and other biological molecules will allow scientists to form multifaceted structures with precisely regulated nanoscale functions. This will range from medicine to molecular machines, nanorobotics to DNA-based computer chips. Chemical engineers will help to bridge the gaps between biology, chemistry, and nanotechnology.

I believe that the optimal growth of biological nanotechnology will be achieved when alternative (*e.g.,* left-handed Z-DNA) and multistrand DNAs and RNAs (*e.g.,* triplex, quadruplex, and pentaplex DNA) are employed. Thus far, most biological nanotechnology is based on classic double-strand DNA. Exotic forms of DNA and RNA will prove to be critical for biological nanotechnology to produce manufacturing materials at cost-effective scales. The use of biological nanotechnology will also result in green nanotechnology, namely, clean technologies that minimize the dangers to human health and the environment.

Claude E. Gagna
New York Institute of Technology
Old Westbury, NY

Improving Energy Efficiency

The article "Easy Ways to Improve Energy Efficiency" (by Alan Rossiter and Veerasamy Venkatesan, Dec. 2012, pp. 16–20) is very refreshing. I belong to the same clan as the authors, thanks to my father, who used to say, "common sense is uncommon." People tend to forget simple ways to save money, whether in any industry or at home, energy saving being one of the significant ones. The final thoughts captured in the last paragraph should serve as a beacon for industry.

I have a few questions, though. What does the cooler on the right-most side of Figures 4 and 5 do? Did the intercoolers need significant cleaning on the tubeside before switching from cooling water to softened makeup water?

Srikant Parameswar
Houston, TX

The authors reply:
The cooler on the right is an oil cooler that gets its cooling water supply from the same cooling tower water circuit; it is not connected to the compressor outlets. [It was shown on the original drawing, but the word "oil" was inadvertently dropped during editing. The figures in the online version of the article have been revised. — *Editor*]

The facility in this example is in Tennessee, on the banks of the Mississippi River. The area's groundwater is of fairly good quality, and the heat-exchanger cleaning frequency was very low. The plant's staff did inspect the tubes and found the tubeside almost clean, but did a simple pressure-jet water cleaning before switching to soft-water cooling. However, maintenance of the cooling tower fan located at an elevation was a nightmare in this site. That problem was another reason for the fast implementation of our recommendation.

Heaven? No, Just Human Error

I enjoyed your January editorial, in which you speculated on alternative futures and even whether there would be anyone left on earth to read *CEP* after 12/21/12. You hinted that if we were reading this edition of *CEP*, the world didn't end. Apparently, you were in error. I read on until I got to the *Process Safety Beacon*, showing the results of the Find the Problem contest, on p. 22. There, in Photo 2, I spotted proof that the world, in fact, did end: the label "Rapture Disk." If the world ended and we are still reading *CEP,* I conclude that to be a chemical engineer is to be in heaven.

Scott Berger
Center for Chemical Process Safety (CCPS)

The Editor replies:
The copy we received from the Beacon Committee was correct. The error crept in when we redid the labels in Photoshop to make them conform to *CEP*'s style. The page was proofread by at least four people, and none of us caught the typo. The online version has been corrected.

This incident reminded us of some important messages that extend beyond process safety: Don't fall victim to seeing what you expect to see instead of what's really there. Don't rely on computers to catch errors. Anticipate human error, and devise processes to prevent mistakes.

We thought we had all of those bases covered by having each page looked at multiple times by multiple people at multiple stages of the editing and production process. In this case, quadruple redundancy did not a fail-safe process make.

Considering the thousands of words in the issue, the fact that the typo involved this particular word makes us wonder if some higher power might have been at work …

ChE Education: One Size Does Not Fit All

Imagine the contrast: One day I read about the oohs and aahs of nano biological technology in *CEP*; the next, a former classmate who is known in the water treatment industry grumbled to me about the inability of engineers to do basic

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calculations in fluid mechanics. I have also heard similar complaints that there are too many in the U.S. who know how to cut and paste genes but cannot manage a bioreactor, not to mention tackling an oil-and-gas facility.

An outsider would think that these are about different professions, yet all are chemical engineering. Increasingly, I fear that our claim of professional versatility is not adequately matched by the capabilities of a typical graduate. This situation is compounded by the structure of academic tenure, in which only those who engage in cutting-edge research have a place, while those working on the more traditional areas are being edged out. So we end up asking non-experts to teach the basics of chemical engineering, such as distillation. What passion or depth of experience could we expect from such instructors?

Perhaps there are true geniuses who could teach any undergraduate subject like a master, even though they are not. But can we risk the health of our engineering education on them? How many of them exist in the first place?

Some major Australian schools have not only realized this chasm, but have also taken drastic corrective measures by letting professors do their pet research full-time, while hiring practicing engineers to teach the "engineering" subjects part-time.

The situation becomes more complicated when we consider the global differences in technological development. Yet many developing nations are trying to join the party by coercing academic staff to do the same type of cutting-edge research cherished by "high-impact" journals. How many taxpaying companies would find the output of such research of any impact? Perhaps a few in the U.S.; but in Nepal, in Myanmar, in Saharan Africa? Of course, there will be counter-arguments that if these nations do not try, their universities and industries will never reach a higher stage.

The critical issues, I believe, are the extent and balance between the old and the new. To this end, not only the developing nations, but developed nations as well, should re-examine the priorities of their chemical engineering education and set appropriate, if different, benchmarks for them. One size simply does not fit all.

Hak Koon Yeoh
Petaling Jaya, Malaysia