

The object of this column is to enhance our readers' collections of interesting and novel problems in chemical engineering. Problems of the type that can be used to motivate the student by presenting a particular principle in class, or in a new light, or that can be assigned as a novel home problem, are requested, as well as those that are more traditional in nature and which elucidate difficult concepts. Please submit them to Professor James O. Wilkes (e-mail: wilkes@engin.umich.edu) or Mark A. Burns (e-mail: maburns@engin.umich.edu), Chemical Engineering Department, University of Michigan, Ann Arbor, MI 48109-2136.

“AN ODE TO THAT DISTILLATION TOWER” And Other Poetry — A Creative Writing Assignment —

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Writing in the chemical engineering undergraduate curriculum generally assumes the form of formal reports in laboratory and capstone design courses, but it is generally accepted that writing assignments should be more frequently assigned and integrated throughout the curriculum. Short writing assignments outside of the standard report format include cover memos for homework sets or open-ended special projects, laboratory safety briefs, or ethical-issues essays of chemical engineering interest.

Informal writing assignments can also promote student learning of engineering concepts. For example, Felder^[1] recommends in-class writing to “define a concept in your own words.” The active process of expressing an idea or concept

in writing helps the student to work through problems with understanding. In other words, writing is learning.^[2] There is generally a much lower “activation energy” associated with informal writing assignments, as content is valued over mechanics.

I wanted to make a short, informal writing assignment that would serve three purposes: It should 1) reinforce chemical engineering concepts relevant to the course material, 2) promote creating thinking, and 3) put a smile on the faces of the serious-minded students in my class. Toward this end, I chose a poem format. The problem statement, samples of poetry written by the students, and a few comments on how well the assignment worked out follow.



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PROBLEM STATEMENT

The writing task was assigned with the last homework set near the end of the term in a senior-level mass transfer operations course. The assignment stated:

“Artistic literary works such as parables or poems offer a way to communicate abstract ideas or concepts that

otherwise would be difficult to understand. In this last homework assignment, I want you to write a short poem (in any format) that attempts to communicate a mass transfer operations related concept to someone with a very basic technical background, say a sophomore in chemical engineering. I will look at these personally and evaluate the work based on the level of thought put into it. Don't wait until the last minute to do this last homework assignment—creativity requires a clear head.”

The assignment was also read aloud in class to gauge the student's reaction to it. The room was filled with laughter and a few groans, but the class as a whole seemed very receptive to this unconventional writing assignment.

STUDENT POETRY SAMPLES

■ Sample 1 • (untitled)

Packing and trays, packing and trays,
Less volume to area, less distillation days.
Valves and saddles, valves and saddles,
Better mixing, less dripping, ChemE's have time to babble.
Sieves and rings, sieves and rings,
Less reflux and boilup, accountants do sing.
Intalox and caps, intalox and caps,
Less fumes and waste, EPA drops their bats.
Packing and trays, packing and trays,
More calculations, but getting well paid.

■ Sample 2 • “Crude Technology”

There once was a mixture of crude
that splurged from a hole, so good.
But it can't be used for squat,
because its volatility is shot!
So rectification is a must,
or the company will go bust!
Feed crude to the tower,
insides filled with trays that shower.
Distill that crude solution...
Heavies flow to the bottom,
lighties rise to the top.
Heat loads on the tower,
more distilled feed is profit by the hour.

■ Sample 3 • “An Ode to that Distillation Tower”

Ode to that distillation tower,
With all its mighty separatin' power.
Takin' one little stream of this and that,
and makin' two streams of mainly this or that.
But don't go thinkin' it's all just touchy-feely,
'cause the rules are spelled out by McCabe and Thiele.
And adiabatic is how she's gotta run,
otherwise no one's goin' to have any fun.
Now with all these rules you're ready to distill,
And with the instructor's help you'll get your fill.

■ Sample 4 • (untitled)

The ascension of purity is finite in steps,
unless one is faced with azeotropic effects.
Breaking through can be attained,
and in Treybal this process is well explained.
So fire up that tower and get on with the show,
but be careful with reflux to control cash flow.

■ Sample 5 • (untitled)

There once was a ChemE named Joe,
Who raised the reflux ratio.
The column did flood,
Now Joe's name is mud,
And he runs the tower no mo'.

COMMENTARY

When the students turned in the poem writing assignment along with the rest of their homework, several asked me to read the poems out loud. I considered the request, but silently read through all of the poems first. I then selected five poems that I thought the class might enjoy and at the beginning of the next class, I read them to the class under the lecture topic “Poem Time.” I did not acknowledge the student authors, to protect those who might feel embarrassed about disclosing their work.

Ollis^[3] claims that reading poetry aloud from established literary works illustrates to students how ideas can be presented with brevity. I noticed that the students were very attentive during the five minutes of Poem Time. This suggests the ChE-inspired poetry, if used sparingly but effectively, can be a unique way to bring

home ChE concepts to students.

I used two simple criteria to evaluate the student work: 1) did the topic illustrate some concept relevant to the course? and 2) was there an attempt to put some thought into the work? Every student except one composed one poem, and some even composed two! Overall, I was impressed with the level of humor and the clever use of language that the students put into their poems. By framing the poem assignment to illustrate a mass transfer operations concept, students attempted to use analogies to explain technical concepts, and in so doing exercised creativity and higher-order thinking skills. Above all, however, an "affective objective," described in Bloom's Taxonomy,^[4] may have been attained. The assignment was perceived as unique and fun by the students. Therefore, their attitude toward the subject area may have been positively affected by the assignment, which in turn would stimulate sustained interest in the subject area.

Students in engineering generally appreciate a diversity of activities in their coursework experiences.^[5,6] A little levity is sometimes needed in senior-level courses where engineering students are burdened with the pressures of career decisions, difficult course material, and time-consuming projects. In

this regard, timing a short poem writing assignment near the end of the term lifted the students' spirits a little and put a smile on this instructor's face as well.

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Letters to the Editors of the "Class and Home Problems" Column

Dear Sirs:

I am writing to you regarding the article "Distillation Column Performance," by J.A. Shaeiwitz, in *Chemical Engineering Education*, **29**(4), pages 240-243 (1995). The problem is interesting in that it sets out to examine operation of an existing piece of equipment rather than designing a new unit (which is the most common form taken by many chemical engineering exercises). However, considerable care is needed with such problems if the wrong conclusion is not to be reached.

In this problem, there are two aspects that really need further consideration.

A. Tray Performance • In many distillation services, small reductions in feed rate will allow pro-rata reductions in all other flows and their related heat-exchanger duties. However, as the reduction approaches 35% of the original throughput, weeping will become significant for sieve trays and mass-transfer performance starts to decline—that is, the required separation is not achieved. Further feed-rate reductions will not permit corresponding reductions in heat loads; the heat input must be maintained to produce sufficient

vapor flows to limit weeping (obviously, the condenser duty and liquid flows will follow). In summary, at low throughputs, the column must be artificially loaded and energy-efficient operation is not possible.

The exact amount of turndown possible depends on where the original 100% point lies in the sieve-tray operating envelope, and the important point to note is that it is unsafe to assume that halving the feed rate allows one to pro-rate down all flows and duties without detailed consideration. If feed rate reductions larger than 30-40% are likely to be required on many occasions, the designer should specify valve trays.

B. Condenser Operation • Most condensers are designed with cooling water flowing in the tubes at a velocity of 1.5 to 2.0 m/s; the very minimum velocity suggested is 1.0 m/s. Generally, a maximum cooling-water return temperature of 45°C is used. Both of these parameters are based on operating experience and are intended to limit heat-exchanger fouling and corrosion. In the proposed solution, a velocity well below 1.0 m/s will result if the cooling water is reduced by