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## SHORT STORIES AS A MEAN TO TEACH CHEMICAL ENGINEERING II

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### **ABSTRACT**

*To achieve the best assimilation of knowledge, professors can use many techniques when teaching the subject Unit Operations in Chemical Engineering. This article shows again that the use of short stories for the resolution of problems may work as one of them.*

**KEY WORDS:** *Chemical Engineering, Mass Transfer, education, short stories, problem solving.*

### **I. - INTRODUCTION**

Chemical Engineering is defined as:

*“... the profession in which a knowledge of the mathematical and natural sciences, gained by study, experience, and practice, is applied with judgement to develop ways to utilize, economically, the materials and forces of nature for the benefit of mankind”.* [1]

As it can be seen from the definition above, the teaching of Chemical Engineering is based primarily on Mathematics, Physics, Chemistry and Engineering techniques that have been developed through experimentation, practice and experience for more than 100 years since the profession exists.

Nowadays, professors of Chemical Engineering at the University rely on the intensive use of sophisticated tools like computing resources, Internet and audiovisual means, to approach the resolution of algorithms and problems, etc.

However, the authors of this article have also explored the use of literature to encourage learning by using short stories in which problems related to Unit Operations are solved.

According to the author's experience, this method is appealing to students who are afraid of

deductions, calculations and other procedures commonly used by professors to lead to the resolution of problems. In a previous article [2] the authors presented a short story to exemplify the method. In this article, the authors present another short story, this time related to Mass Transfer and to the diffusivity of water in a surface of clay. We hope that the readers can follow the calculations and get the same results that the hero of our story.

### **2. - PRESENTATION**

#### ***Daydreams***

*“A cylinder of clay is exposed to almost dry air. Water diffuses to the surface and then evaporates into the air. The surface humidity is constant and equal to 7% by weight.”*

The engineer Estanislao dictates a problem at his usual speed and I can barely follow him. I hope that later I can understand my awful scribbles.

*“After five hours of drying. What is the concentration of water in the geometric center of the cylinder, if the initial concentration was of 35%?”*

As the teacher dictates the problem to us, he walks from one side to the other of the room taking large steps; a motion that hypnotizes me.

“The diffusivity of water in the clay is eight multiplied by ten raised to the power of minus six square meters per hour.”

While I transcript what he dictates I observe his thin figure sheathed in a black suit. A smile seemed to cross his wrinkled face. Why is he smiling? Did he remember something?

“The convection coefficient is very large in comparison with the diffusion coefficient of the water in the clay”

Water, clay, mud, sand, sea... How nice it would be to be now in the sea! I wished I was under the sun, with a coconut with gin in one hand while I use the other to stroke Rosaura’s body. I could feel the salt air spreading through my lungs and Rosaura’s warmth disseminating through my body.

“The dimensions of the cylinder are three by three centimeters.”

*As Rosaura’s dimensions. No, what nonsense! Those must be equivalent to the size of her little mouth or her big eyes.*

-Mr. Jose Lopez, come to the blackboard!

*And his sculpted body must be 92, 60, 92. No, maybe 92, 65, 94. I really don’t know. Next time I will ask her... or better, I could take the measures myself.*

“Mr. Lopez. Wake up!”

“Pepe, Pepe, wake up! The teacher is talking to you!”

“What, whaaat? Of course, Professor!... What did you say?”

The entire classroom broke out laughing.

“Stop daydreaming and come to the board.”

“Yes, Professor! I’m coming!”

I rose and approached hearing the laughs and taunts of my classmates. While I descended, the room seemed to grow; even the tiny figure of Professor Estanislao.

Finally, after a few moments that felt like centuries, I arrived to the podium.

“Good, Mr. Lopez. Now that it looks like you are already woken, could you tell us how to solve the problem?”

“The problem?”

“Yes, the problem I just dictated. Didn’t you transcribe it? Mr. Ramirez, share your notes with Mr. Lopez to refresh his memory.”

Gus, as the bootlicker he has always been, smiled and handed me his neat and succinct notes written with a superb handwriting. I hastily read the problem as I felt over me the eyes of everyone in the classroom. They didn’t want to lose any detail so that they could have fun with my stupidities. Professor Estanislao observed me closely. His eyes seemed to sparkle; he also wanted to have fun with me.

“Well? Have you finished reading? What do we do now?”

“Could I draw a diagram of the cylinder and specify the variables?” I asked with an almost inaudible voice. I was stammering in panic.”

“Go ahead, Mr. Lopez.”

I took the chalk and started to draw slowly. Calm returned to me little by little. Everything is a matter of mastering the nerves. You have to breathe deep to banish fear and be able to act. That’s all you have to do to make a good performance before a ferocious public.

“Well Mr. Lopez, you have already done a scheme, on other words, the translation of the problem to represent the geometry and the characteristics of the piece to dry. What’s next?”

“Now,” I say more confidently “I must describe the approach. I mean, I have to indicate how to solve the problem without solving it. I’ll just present the calculations and equations that can lead us to the resolution.”

“Excellent, Mr. Lopez! I see with pleasure that you had studied my method for the resolution of problems [3]. Well, put it into practice.”

While we were talking about it, I reviewed mentally as fast as I could all the vast farrago of equations that we had seen during the course, trying to find the right one.

“There are several ways of solving this problem, Sir.” I said.

“There are? Show me!”

I was getting in trouble. If I fell, he would shred me and my classmates would devour my pulsating guts. But I remained calm and... I got it. That was it!

“There are graphical methods,” I said aloud “and analytical methods. On one hand we have the graphical method of Schmidt [5], and in the other, the analytical method which is based on the series of Fourier and Bessel [4]. Ah! And you can also use the graphs from Lourie and Gourney [6].

My words fell like a sledgehammer over the heads of my colleagues; all were silent and observing me with disbelief. How I remembered all those names? It was amazing! I would have to pray a novena to my guardian angel.

“Well, Mr. Lopez,” answers the teacher “you surprise me. And which do you believe will be the most suitable in this case?”

“Since it’s a short cylinder, the analytical solution is complicated; so, I think that for this problem the best and, most important, the quickest way to solve it would be the graphs from Lourie and Gourney. Although we would have to use two graphs to come up with the solution: one for the infinite cylinder and one for the infinite plate [7].

The expression of the Professor Estanislao softened. He smiled, and then he opened his arms as if he

wanted to take me between them. Everyone was astonished. Gus was green with envy and most of my peers had their mouths open.

“Well, Mr. Lopez.” told me the professor “Proceed.”

I opened my calculator without hesitation, and with extraordinary speed I solved each calculation, one after the other. The board was filled with numbers, drawings and equations. Then I took the graphs that the teacher gave me. I found the abscissa parameters within the graphs and got the result at the coordinates. I made a couple of operations more and I finished.

“In accordance with the calculations, the concentration will be of eleven per cent.”

“Excellent, Engineer Lopez” said the Professor, emphasizing the word “Engineer”. Then he turned at my classmates and said: “Take him as an example. I wished I had more students like him!”

I descended the podium and went to my place. I felt lighthearted, proud, conceited like a peacock. I could feel the looks of respect, approval and admiration, but also of envy, and those were the ones I found more pleasing. I got to my desk, and closed my eyes to savor my triumph more deeply, but someone pushed me by the shoulder.

“Pepe, Pepe! Wake up, man! The teacher is talking to you.”

“What, whaaat? Of course, Professor!... What did you say?”

The entire classroom broke out laughing.

“Stop daydreaming and come to the board.”

“Yes, Professor! I’m coming!”

### 3. - CONCLUSIONS

There are numerous techniques that teachers use to attract students attention in Chemical Engineering classes. This article shows a technique based on the resolution of problems through short stories. After employing this technique over several semesters at the University, the authors believe that this procedure improves learning by making it more attractive and fun to students.

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