# Chemistry Chat

## Nine Short Stories - Part 2 -

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Column chromatography is one of the most difficult techniques to master in organic synthesis chemistry experiments. There are many points to pay attention to, such as how to pack the silica gel, selecting the solvent, and switching the fractions, and a lot of experience is required. This time, I would like to talk about column chromatography.

## Story 4. Unfairness

Mizuki was preparing for the column chromatography. He added a slurry of silica gel to the column, but silica gel was tightly packed in some parts, and was packed with fluffiness in other parts. So, he tapped the column from the side to pack all the parts tightly. After adsorption of the reaction mixture, he ran the eluting solvent. Some parts went fast and some went only slowly, which looked like a devil's claw. Naturally, there was no way to get a clean separation, thus he had to combine and concentrate the fractions, and redo the process from the beginning.

⇨ In the experiments of column chromatography, packing of silica gel is considerably important. There are two points to do well: packing homogeneously and keeping the adsorption surface horizontal. Mizuki tapped it **from the side**, so **the side that was tapped was packed tightly while the other side was loose**. It is just like humans who become perverse when they are treated unfairly. From my experience, it is effective to add silica gel like snowflakes through solvent and then tap the **top of the column a couple of times** for packing homogeneously. Of course, other professors and labs may use different methods, but I am not dismissing those methods by any means.

## Story 5. Crack generation

Fumiko was separating the reaction mixture. She was able to pack silica gel tightly and homogeneously, and then, she began development. Because a horizontal ring came down, she thought, "So far, so good". When she switched the eluting solvent from hexane to dichloromethane, the silica gel lifted up with a bumping sound as the dichloromethane was lowered, and a crack generated. The dichloromethane advanced repeatedly, and by the time it reached the outlet, there were several gaps in the silica gel. Any satisfaction that had been gained by packing silica gel homogeneously was lightly blown away, leaving only a sense of disappointment.

⇨ **When solvents of different polarities are mixed, heat of admixture is produced.** If a solvent with a low boiling point and high volatility is used, **the heat may cause it to vaporize**. It may not be a problem in an open system. However, in a closed system, namely in packed silica gel, there is no escape route for the vaporized solvent. After generation of several cracks, separation cannot be performed anymore. If you switch to a solvent of very different polarity, it is better to run a small amount of solvent of intermediate polarity before it.

## Story 6. Nonlinear

Mizuki observed four spots on the thin layer chromatography (TLC) of the reaction mixture. Since each of them had relatively different $R_f$ values, the separation seems to be easy by column chromatography if the polarity of the eluting solvent is gradually increased. Therefore, he increased the ratio of ethyl acetate to hexane by 20%. However, four spots were observed in one of the fractions, indicating that they could not be separated at all.

⇨ One of the difficulties of column chromatography is the selection and switching of the eluting solvent. If you can elute with a single solvent, it is not necessary to think about the switching so much. On the other hand, you should consider what ratio to use and when to switch eluting solvents if you use mixed solvents. There is a big difference between 1% and 2%, but between 30% and 50% is not so different. In other words, **you should increase with small steps up to about 10%**, but after that you can increase it roughly. You change the pattern of behavior depending on the surrounding situation. It is similar to experiments.

## Author Information

**Professor Nagatoshi Nishiwaki** received a Ph. D. in 1991 from Osaka University. He worked in Professor Ariga's group in the Department of Chemistry, Osaka Kyoiku University, as an assistant professor (1991-2000) and associate professor (2001-2008). From 2000 to 2001, he was with Karl Anker Jørgensen's group at Århus (Aarhus) University in Denmark. He worked at the Center for Collaborative Research, Anan National College of Technology as an associate professor from 2008 to 2009. Then, he moved to the School of Environmental Science and Engineering, Kochi University of Technology in 2009, where he has been a professor since 2011. His research interests comprise synthetic organic chemistry using nitro compounds, heterocycles (synthesis, ring transformation, 1,3-dipolar cycloaddition, application as tools in organic synthesis), and pseudo-intramolecular reactions.