Chemistry Graduates and Expectations of Industry

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Who is a chemistry graduate? Universities and other teaching establishments such as the Institute of Chemistry Ceylon offer a variety of courses of study containing chemistry as a subject generally stretching from 3 to 4 years. Several universities in Sri Lanka offer 3 or 4 year full time courses of study and what is traditionally known as a special degree in chemistry is a 4 year full time degree with several subsidiary science inputs and with focused full time teaching of chemistry in the final year, a research project and limited exposure to industry as well. A long time ago the 3 year courses had a one third input in chemistry but now courses are offered with even a lesser input and as such for the purpose of this article we shall only consider graduates who have more than 50% chemistry content in the total course work done over a period of not less than 4 years so that Graduates of the Institute of Chemistry could also qualify to be considered as Chemistry Graduates even though the courses followed by them are in the main part time. Yet for all, the Institute's Graduates have gone through a syllabus whose chemistry content in both theory and 'practicals' is no second to that offered by the best of universities in this country. Further they have been taught by the best of teachers drawn from several universities, Institutes and Industry. Be that as it may, although the official position of the Institute is that the Graduates it produces are equivalent to the chemistry special graduates of reputed universities of this country, **what matters most is what the customer thinks about the product rather than what the producer feels about his own creation**. In this article we shall therefore take a closer look at the likely expectations of employers or external customers of teaching establishments so that graduates and others could evaluate to what extent the courses of study they have followed have contributed towards achieving such requirements.

It is well known that a syllabus of a 4 year course of study in chemistry referred to above is geared towards imparting to the student a good understanding of the basic theory which spans the traditional areas of inorganic, organic, physical and analytical chemistry coupled with a series of desk top practical studies, hopefully to reinforce the understanding of the theory which is dished out in the form of numerous lectures delivered by well qualified lecturers whose variety is no second to that of the subjects covered, thereby exposing the students to a rather complex methodology of teaching which hopefully (though unintentional) would prepare them to face a complex world. In addition, graduates in chemistry will emerge with an input in various disciplines of chemical sciences such as natural products chemistry, polymers, industrial chemistry and food science to mention a few.

There is little doubt that the **emerging chemistry graduate has been well prepared for further higher studies in chemistry** and as such those graduates who attain a good class would take a journey towards attaining a doctorate as a fish would take to water. The universities have so far insisted that Graduates of the Institute of Chemistry complete a Master of Philosophy degree prior to registration for a Doctor of Philosophy even when such Graduates have attained a 1st class. One reason may be because the Institute's graduates who have qualified so far have not done a research project. However this matter has been now resolved and research opportunities are now available for Graduates to do such projects. The problem seems to be compounded by the part time nature of the course as it does not seem to address the expectations of some of the premier research Institutes of this country. A recent newspaper advertisement of one such Institute calling for applications for the position of Research Officer Grade 4, requested only those having a B.Sc. (Hons.) Degree in Chemistry with a 1st or 2nd class upper or those with a 2nd lower with a postgraduate degree or those with a B.Sc. 3 year degree with a 1st or 2nd upper and a post graduate degree by research, to apply. The expectations of this premier research institute appears to be that, a chemistry graduate should have had at least 4 years of full time training and indeed a good class as well. The advertisement also states clearly that the applicants must have a degree, but no provision has been made to recruit those who have graduated with equivalent qualifications from professional institutes. **It is indeed most unfortunate to have the doors shut on the good graduates of the Institute as probably their knowledge of chemistry and brilliance and indeed the overall training they have received could well surpass that of others with formal degrees from universities**. It is high time organizations start looking out of their box and discover the strides made by non government teaching establishments such as the Institute of Chemistry Ceylon, which now offers a highly upgraded course of studies to what was offered previously. If the Institute began producing graduates 25 years ago with scanty resources, and with a modest syllabus as well, let not those poor first impressions some of the early graduates may have made with employers be held as an indelible blot. Over the past 25 years the Graduateship

Programme has improved considerably and today, even if the course of studies is held by some to be unworthy of recognition to be on par with a special chemistry course of studies offered by a university merely on account of its part time nature, it is felt that **Graduates with high attainment who have proved themselves with a 1st class or 2nd upper should not be down rated in comparison to a special chemistry university product. On the contrary it can be argued that if such an excellent performance is possible even with part time instructions, such graduates must surely have a streak of brilliance that is brighter than that of others.** After all, **what is more important is full time learning than being taught full time.** In other words the graduate who listens to lectures over the week end has the rest of the week to read, digest and assimilate what he has listened to, and spend more time in the library. The proof of the pudding lies in the eating and it is no small wonder then, that the Institute has been able to produce as many as seven 1st classes this year. Who will dare say that they know less chemistry than those with lesser attainment from universities and yet receive greater recognition by some organizations. This unhealthy state of affairs must change and sooner the better. **We need to promote greater competition between graduates produced by the state and private sector.**

If the syllabus content in chemistry and the facilities offered by the Institute of Chemistry, are no longer second to that offered by a university, would the graduates of the Institute be on par with the special chemistry degree holders of universities? There is no clear answer to this question, as facilities alone are not responsible for the quality of the product. The Institute must refrain from claiming equivalence and instead strive to claim superiority. To claim equivalence is to admit superiority of the competitor and in a competitive world that must clearly be not the case, especially when the Graduates produced by the Institute are clearly more acceptable to many quarters in view of the unique features they have. **The approach of the future clearly must be to offer a differentiated product rather than a similar or equivalent product** How then are the Institute's Graduates more superior to that put out by the universities? **The superiority of the graduate is in the overall product features and not in the chemistry content alone.** Therefore, the Institute has in recent years been able to introduce some unique features of learning by incorporating language modules which give a working knowledge in both sinhalese and tamil to all graduates, a comprehensive management module which gives a good understanding of how to manage a work place with operations management and problem solving inputs as well, and starting this year a whole heap of optional modules in applied sciences and industrial chemistry have been introduced to meet the expectations of industry.

It is a well known fact that **the quality of a product greatly depends on the quality of the material inputs.** The production of Graduates is no exception. What ever the product, it is not possible to produce high quality products using poor quality materials and as such **there is no substitute for an undergraduate's natural brilliance and genius which contribute towards producing excellent graduates. It is here that the universities score over the Institute in earning a good image for her products.** Quite apart from the fact that the cream of the country enters the universities *via* a highly competitive entrance examination (A-levels), it is well known that out of those following science only a limited number of the very best students are selected to do the special chemistry degree. **The image an organization earns for itself does not depend on how excellent some of the products are, but on how excellent all the products are.** It is the few bad products that ruin the image and destroys the perception of the customer in respect of reliability of the product. Over the years the universities have protected the good image of special chemistry graduates by picking a limited number of the very best students to follow this course and thereby **have virtually created a brand image for this excellent product of theirs. It is no small wonder then that the academic reliability of a special chemistry graduate of a university is so high.** It is this type of brand image which drives research institutes to pick university graduates. If the Institute too desires to build a strong brand image for her Graduates it too may have to sift the input and permit only the very best students to follow the four year programme. It is heartening to note that the Institute has introduced two new exit points which enables students to qualify at the completion of 2 years with a diploma and after 3 years with a higher Licentiateship qualification. This indeed is an opportunity, for self evaluation of one's own capability and for those who realize that chemistry is not their cup of tea to seek fresh pastures else where.

Pursuing further studies in chemistry and obtaining a masters degree or a doctorate by research means that the graduate invariably prefers to follow a career in research or teaching and I dare say that such a training goes well to meet the expectations of the employer who seeks academic excellence in the individual. These graduates then belong to that class of employee known as a knowledge worker who loves freedom to think and act with low interference from others and who loves to operate in a domain that is intellectually gratifying. Such graduates invariably end up in the university system or in a research laboratory environment. Very often these are comfortable zones to the extent that whether you are good or bad at teaching or doing research, one's job is hardly threatened. The quality of the output is far too often measured only by success stories, and failures are swept under the carpet. Far too often experiments result in only chemicals going down the sink and the researcher

is never held accountable and far too often too many students fail to understand their teachers and always the problem is said to be the student and never the teacher.

Apart from research institutes and universities, industry too employs chemistry graduates. The key expectation of industry of a chemistry graduate is no different to what is expected of any other graduate. **What industry expects most is ABILITY TO PERFORM**. What then does that mean? It simply means that the graduate should have the **capability to set challenging goals and achieve them on time.** Good performance is the sweet distillate of one's knowledge and skills. Knowledge is the science you carry or the understood information or theory in one's head. Skill is capability, and knowledge alone is insufficient to be capable. One needs practical experience. This, the raw graduate of chemistry will have only to the extent his experience in the applied world would dictate to him. It is for that reason a university degree programme requires a student to spend some time in industry doing a semester long project or internship. After all it is quite easy to understand how a batsman hits a six but it is far more difficult to hit a six unless you have developed the skill to do so with practice. Even if you do not have the skill to be able to hit a six you could probably excel in the theory of the art of hitting a six and end up teaching it to others as well. Needless to say the chemistry graduate's performance and the capability dimension gets compared with that of peer graduates of other disciplines, such as engineers, information technologists, and chartered accountants all of whom have roughly spent the same length of time qualifying. The nature of the subject and the training is such that the practical day to day contribution of an engineer, an IT person and an accountant is seen to make a tangible contribution towards organizational performance rather than that of a fresh graduate in chemistry who would probably have to learn much more of the chemical processes in the industry before a problem solving capability is acquired. This is because of the very nature of the courses followed. **The all important question is then, to what extent has the chemistry course imparted a problem solving practical capability as this is a high expectation of industry.**

The training a chemistry graduate receives over the four years of the first degree and over perhaps another three years doing a doctorate is one where the graduate is trained to excel by singular effort and as such a mind set is developed which promotes individualism. **Here then is the first dilemma a fresh graduate faces in industry which expects one to work in teams and share information with others and achieve goals collectively**. Success or failure belongs to everyone. Therefore a key expectation of industry is to be able to recruit graduates who love to work in teams and develop team spirit. In order to have such attributes graduates must have good inter personal skills. Therefore **another key expectation of industry is that graduates should have excellent communication skills** in both oral and written form. **Graduates have to contribute towards discussions**. Far too often chemistry graduates are seen to be silent observers at meetings as they are unable to express themselves and are mistakenly considered to belong to that class of person who believes that, "if you are a fool it is better to keep your mouth closed than open it and leave no doubt about it". Industry expects graduates to be able to analyze and interpret results and write clear concise reports. They need to have the ability to use appropriate soft ware and present information clearly.

Another very important expectation of industry is that graduates should be able to manage their time between overlapping tasks. They should have a good idea of, scheduling and sequencing and of other industrially important quantitative methodology, especially if the chemistry graduates are seeking a career on the factory production floor. Needless to say many of the graduate chemists who enter industry find a home in a laboratory and works in the area of product development and quality assurance. Such graduates are **expected to carry with them good laboratory technical skills. The graduate needs to have an appreciation of the market the organization he serves,** and also an **appreciation of the need to carry out development work in a multidisciplinary approach**. There is no way in which the chemistry graduate in industry can take his eyes off the materials / machine interface. In product improvement another important dimension is costs. Therefore **industry expects graduates to be cost conscious and who will be able to find new materials that are both cheaper and better**. Industry is increasingly becoming conscious of the need to be environment friendly. The **chemist has an important role to play in managing chemical waste**. Graduates who have received a good input on chemical waste management will be an advantage. Therefore, **industry expects to have graduates in chemistry who have received a reasonable exposure to the complexities of the chemical industry**.

DuPont, USA an international giant in chemical and polymer synthesis **seeks chemists as researchers with the needed skill base. They should have the technical edge to talk with credibility, and ability to use modern computational techniques, modeling and information technology to be able to take an idea and convert it into something of substance**. They should have the **ability to collaborate and work in teams** and should try to be **a non conformist**, be **courageous and committed**. Universities provide education that develop some of these requirements and the organizations develop the balance in house. In globally competitive industries key to profitability is often productivity. Therefore, chemistry graduates must not only have desired technical skills but **should have practical attitudes**.