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TITLE: **The Use of Personal Computers in the Phosphate Industry**

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ABSTRACT

Personal computers have taken the chemical engineering profession by storm. Here in central Florida they can be seen on the desks of most chemical engineers. Some of our colleagues have become advanced users; others are still struggling to learn the mysteries of DOS, Windows, and related applications.

The purpose of this paper is to provide an overview of the various uses of personal computers to maximize productivity and efficiency. Some basic uses will be skipped. We will concentrate on spreadsheets for engineering calculations and material balances, advanced mathematical software, process simulation applications, communications software for e-mail and access to the Internet, and process control.

The presentations will include two viewpoints: That of a consulting firm who is mostly concerned with process simulation and plant design, and that of an operating company, with emphasis on process control and statistical data gathering.

We do not expect that any of you will become experts as the result of this presentation. Our primary goal is to make you all aware of the potential that is available to us and to encourage a greater level of participation and usage. We will be happy to entertain individual questions after the session.

INTRODUCTION

A review of papers presented at this convention since day one will reveal that a few, but not many papers have been presented on the topic of personal computers and chemical engineering. This is not surprising, since this convention predates personal computers. The first Clearwater meeting took place in 1977. Yet, the first PC was introduced in the mid 80's. Since then, PC's have grown, and changed at a pace no one could have predicted.

The first significant player in the PC world was Apple, who followed its initial offering with the MacIntosh. Both the original Apple, and the MacIntosh featured a visual interface in which the user could use a mouse to guide the various commands and functions. This interface concept spared the user of the painful learning curve of the IBM PC which depended on DOS commands, and making sure that the various peripherals were compatible with each other as well as with the programs or applications.

The convenience of Apple computers came, however, at a price. The IBM compatibles were always sold at a substantially lower price. Also, IBM compatible software featured greater variety and availability. Initially, IBM staged a marketing coup by making its operating system available to its competitors. By doing so, IBM lost its market preeminence, but created an industry standard. Only recently has Apple allowed its system to be used by others. This move may have come too late for Apple. Since Microsoft came out with its "Windows" interface, it has rapidly become a de facto standard, and has captured an overwhelming market share. Recent articles in the financial pages point to the eventual demise of Apple. "Sicut transit gloria mundi."

Because of the above considerations, this paper will deal with the Microsoft Windows/IBM compatible systems exclusively.

USES OF PC's BY CHEMICAL ENGINEERS

Personal computers, as well as laptop or notebook computers have become a common sight on the desks of chemical engineers. In fact, most engineering schools require their incoming students to own a PC, thus assuring their computer literacy. In most cases, the PC is provided by the engineer's employer, and in many cases, these computers are networked or linked together.

We can think of several major applications which chemical engineers use. The first one is **word or text processing**, with the two leaders being **Word Perfect** and **MS Word**. Once upon a time, if an engineer needed a document written, he or she would either write it by hand, or perhaps dictate it, and then it would be transcribed by a secretary. Now, it is common for engineers to write their own documents directly by means of a PC and a word processor. This will allow speed and much greater control over editing.

Another major application is the **spreadsheet**. Market leaders include **Lotus 123, Quattro Pro** and **Excel**. Spreadsheets will allow the preparation of tables, engineering calculations, and the processing of large amounts of data, the proverbial "number crunching". Spreadsheets can also function as databases, and create graphs and graphics.

If I had to select one and only one program to have on my own PC, I would probably select a spreadsheet, since it would allow me to handle numbers, text and pictures. For example, I now create what I call "intelligent" flow diagrams, which are prepared using the Quattro Pro spreadsheet. On these flow diagrams, which combine graphics, numbers and text, to show a material balance and simplified pictures of the equipment. We recently had a project in which we had a large number of options, the typical "what if" scenarios. Here we combined repetitive calculations for various conditions, to give us equipment sizes and cost estimates. In a sense, this is an elementary case of process simulation and it is very useful for preliminary engineering.

Another application for spreadsheets is cost estimating. At this time, we have done this so may times that we have templates for different types of plants and by simply plugging in cost figures, we can come up with total costs very fast.

Many types of engineering calculations can be done on a spreadsheet. We do heat exchanger calculations, pressure drop, distillation column sizing, valve sizing, etc. The potential is endless. We should note here, that many vendors will provide free, or at nominal cost, proprietary programs for many of these calculations. We have tried many of them with mixed success. One major problem is the equations used are not well documented or nor documented at all. Thus it is not possible to judge the accuracy of the results. In other instances, if there are any problems, there is no way to troubleshoot the problem. In our company, the tendency is to write our own templates for various calculations. This way, if there are any problems, we can do our own troubleshooting

There are other programs such as TK Solver and Mathcad which can be used for mathematical functions. They can handle very advanced calculations, but are limited in other areas. Thus, while we do own one of these programs (TK solver), we generally favor the use of a spreadsheet (Quattro Pro) because of its versatility.

One feature we use extensively consists of the export of data from our drafting program, AutoCad, into Quattro pro, such that we can automatically prepare lists taken from AutoCad attributes for equipment lists, instruments lists, valves lists, pipelines tabulation, etc. Furthermore, we have mastered the concept of preparing a material balance on Quattro Pro and then incorporating the information into the Process Flow Diagram . One of the slides shows an example of this.

Which brings us to CADD, meaning **computer aided design and drafting.** A few years ago a controversy raged on for quite a while as to the economic feasibility of CADD systems. It was said that a $5,000 CADD workstation could not compete against a $500 drafting board. The truth of the matter is that this assertion is correct. If CADD were to be used simply as a glorified drafting tool, it would not be cost effective. However, CADD opens a complete new world of design capabilities. The incorporation of repetitive details or "blocks", the ability to "recycle" drawings, the coordination and automatic updating of "linked" drawings, and the integration of CADD with other applications such as spreadsheets means that CADD can be used as an engineering tool, with great flexibility, speed, and cost effectiveness. Thus, in our opinion, the argument is over. CADD is no longer a drafting tool, it has become one more instruments at the disposal of the engineering profession. Yet, a good number of drawings are still prepared manually, something quite beyond our comprehension.

Of the various CADD programs in the market today, it seems that AutoCad by AutoDesk and MicroStations by Intergraph are the market leaders. Other low price programs exist, but they are not used extensively by industrial organizations.

Another type of application of interest to chemical engineers is process simulation, with a good number in existence. These programs feature a combination of data bases, calculation of individual unit operations, material balance capabilities and in some instances limited process flow diagram drafting.

One of the earlier and probably best known is ASPEN, used extensively in academia and very large industries. However, its use is restricted by its price tag. Other programs such as ChemCad III by ChemStations feature almost as much power as ASPEN, but at much lower price. Still other programs feature various combinations of power and price. Yet, none seem to have become the market leader at this time. In our company we have selected ChemCad, but we admit that many other programs are equally cost effective.

Many other PC programs and applications exist . I mentioned earlier that, in many cases, these are provided by equipment manufacturers at either low or no cost. These programs can be very useful, but can also lead the user into a false sense of security. Generally, in our company, we prefer to enter the appropriate formulas into a spreadsheet and do the calculations from scratch. This way we know where the results come from, and can troubleshoot any potential problems.

One of the most recent applications useful to chemical engineers is communications. This can take many shapes and forms, but they all require either a modem of some type or an interface device such as an Ethernet card. This hardware will allow an individual workstation to be connected with others in the local area network ("LAN") or into other remote workstations, or into the Internet.

The potential for communications is enormous. Messages and data can be sent and received within the organization through the "LAN", or communications can take place with the rest of the world. These "external" communications can be direct, that is modem to modem, or can be routed through the Internet. Significant savings can be accomplished. For example, sending a drawing to a remote location via next day courier can cost approximately $15 within the USA and as much as $50 out of the country. The same drawing can be sent via the modem as an attached electronic file for less than one dollar! This, of course, requires that the recipient have a modem, which unfortunately is not universal yet. I can cite one specific case in which we actually gave a modem to one of our clients for the sake of expediting communications! The cost of the modem will be much less than our total next day air courier service for the duration of the project.

The uses of the Internet are numerous. In our company we find that the approximate split of our usage is 90% research, 9% e-mail and 1% marketing. The access to data and documentation is absolutely beyond belief. We have actually downloaded files containing technical data, OSHA documents, atmospheric statistics, etc. To obtain this information the traditional way by physically going to different libraries and document centers would imply a tremendous cost in manpower as well as travel. Yet, the information received over the Internet is essentially free (at least for the time being!), and the connection cost extremely moderate.

Last but not least is the use of PC's in process control. As you all know, very large and sophisticated process control systems are available in the market today. We are all familiar with PLC's and DCS's. Distributed Control Systems run complex, multi-controller processes. Programmable Logic Controllers run individual pieces of machinery or units, and can be networked to run entire plants.

These systems can be very powerful, but such power comes at a price. The PC's come to our rescue! A trend is being established today in which PC's are used directly for data gathering and process control via direct programming. This allows a level of customizing not always available with the "canned" systems. They are becoming a popular interface to control systems and are the preferred choice for managing data.

Furthermore, by creating a process control program from scratch, the process engineer can have a higher level of understanding as well as control. In some instances, PC's have been called the "poor man's" DCS, by allowing the creation of very sophisticated control systems. Some programs such as Visual Basic allow the introduction of stunning graphics, such as the picture of a control panel, which combined with the operational logic allow the creation of a stand alone process control system.

In other cases, a program can be written to interface with a DCS and test the capabilities of the system prior to start-up of the plant. We know of another case in which an instrument contractor can remotely access the control system of one of the clients and provide real time troubleshooting. The possibilities are endless.

Now that I have gone into a lengthy dissertation about the various types of applications available to us chemical engineers, I will get you all confused by saying that it will probably all change! Let me explain. We humans make a distinction between text, numbers, pictures, etc. Because of this, we make a distinction between word processing, spreadsheets, graphics programs, etc.

However, to a computer, it is all a string of binary numbers to be stored and processed. The computer could not care less what we call a specific application or file. With the advent of Windows, the various applications can be merged into each other and files can be copied, combined, exported, imported, etc. Some applications are being sold as "packages". For examples, Word Perfect now comes packaged with the spreadsheet Quattro Pro. Microsoft Word is sold in conjunction with Microsoft Excel and Power Point. Other packages offer similar combinations. As time goes by, these packages will achieve a greater level of integration which may eventually include drawing applications such as AutoCad, process simulation, and communications.

Thus, an engineering workstation based on a PC will become a truly integrated tool that will allow us to perform the various tasks we are used to. We will be able to write a project scope, do a cost estimate, a material balance, generate flow diagrams and P&ID's, equipment specifications, arrangement drawings, detailed plant design, construction bid packages, etc., etc., etc., regardless of whether it is text processing, "number crunching" or drafting. Then, we will be able to take all of this information and send it to a client, or to another plant site via e-mail at very low cost. The information thus generated will go to equipment suppliers and construction contractors so that the plant can be built.

"As built drawings" will be generated at the site and the design package updated as the construction goes on. Ultimately, the design package will become part of the operating manual and the process control system.

In view of the recent advances in technology in general, and computers in particular, I am sure that my predictions, not only will be realized in a short time, but may fall short.

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