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Applichem (A)

> The Gary [Indiana] plant had had obvious problems for years. It was an ineffective operation. It had a fiefdom type of management. The people had grown complacent and inefficient. They had lost their technical curiosity. And the state-of-the-art technology was in Frankfurt. In the late 70's, when I was business manager, I tried to get them to invite Ari (the Frankfurt manufacturing and technology expert), to Gary. After months of talking, they finally invited him to get me off their backs.
>
> In the Fall of 1981, we [top management] had a meeting reviewing our 10-year plan. After my part, I said that I was going to shift production of Release-ease and another product from Gary to Frankfurt as fast as possible. I almost got punched in the mouth for that. We had-been working on it [the Gary plant] for years. But we were not doing anything! At Gary there were still 1300 people putting out 300 million pounds of material a year. At Frankfurt, 600 people put out about 10 percent less material.

J. S. (Joe) Spadaro, Vice President and Director of the Plastics Business, was discussing the conditions in Release-ease manufacturing which led him to request a study of comparing productivity at six Release-ease plants. He had requested the study in June 1982, and it had been finished in September 1982.

Spadaro had joined Applichem in 1956 when he was 27. His bachelor's degree was in mechanical engineering, and he had held several jobs before that, including managing a machine shop, but not including anything related to the chemical industry. His first assignment had been in Italy where he spent 10 years; then he had spent 5 years in the U.K. before returning to work at corporate headquarters in Chicago.

Business Background

Release-ease was a specialty chemical. Applichem developed it in 1952 in response to a customer's request for help in formulating a plastic molding compound which released easily from metal molds after compression molding. It was sold as a dry powder.

Making molded plastic parts is much like making molded jello. Both jello and the plastic molding compound are hot and liquid when put in the mold; both harden as they cool. Both tend to leave residue on the mold after they are unmolded. Washing a jello mold is easy, and the mold is

This case was prepared as the basis for class discussion rather than to illustrate either effective or ineffective handling of an administrative situation. Names of individuals and certain financial data have been disguised.

rarely needed again immediately. But molds for plastic parts are precision stainless steel; they can be difficult to clean; and they are used repeatedly, with unmolding and cleaning being the bottleneck.

When a customer requested help in cleaning molds quickly, Applichem applications engineers came up with "Release-ease." It was a chemical to be added in low concentration to the plastic molding compound during its manufacture so that the molded parts would be easier to separate from the mold and would leave the mold cleaner. Release-ease was widely used in molding plastic parts.

Applichem had held the patent, and the product family had been a steady sales and profit generator for the company through 1982. Applichem had done no research on the Release-ease product or process after about 1953. What product and process changes there had been were made by manufacturing people in the plants. And most of those had been made by Aristotle (Ari) Pappas, Manager of Release-ease manufacturing at the Frankfurt plant.

The specifications of Release-ease varied slightly among regions. Over the years as customers encountered problems in their molding processes, Applichem's applications engineers had worked with them to identify aspects of Release-ease or other aspects of the customer's process which could relieve the symptoms. The process was one of trial-and-error. Customers were also continually finding ways to use lower concentrations of Release-ease to achieve the same results. In 1982 Applichem's market research group expected little net increase in demand for Release-ease during the next five years.

In Europe suspendability of the particles in liquid came to be an important property, and most promotional literature stressed this property. Competition was fiercer in Europe than in the U.S.; quality and product specifications were more closely monitored there. Several managers told the casewriter that they were convinced that Release-ease made in the Frankfurt plant met specifications better than that made in other plants. There were two other important differences in customers' uses in Europe and the rest of the world. First, European customers used their Release-ease within one year of purchase, whereas some final customers in the U.S. would use it as long as 3 years after manufacture, and customers in other regions varied between the two extremes. Second, European customers purchased Release-ease in 50-kilo bags, but customers in the U.S. and Japan used packages in many sizes from ½-kilo on up.

Release-ease sold at an average price of $1.01 a pound. Applichem's Release-ease sales by region, production by each of the six plants, as well as exports and imports by region (all in millions of pounds) were as follows:

	Sales	Plant	Actual 1982 Production	Exports by Region	Imports by Region
North America (incl. Mexico and Canada)	32	Gary Canada Mexico	14.0 2.6 17.2	14.2	12.4
Western Europe (incl. Middle East and Africa)	20	Frankfurt	38.0	18.0	0
Latin America	16	Venezuela	4.1	0	11.9
Pacific and Rest of World	11.9	Sunchem	4.0	0	7.9
Total	79.9		79.9	32.2	32.2

Applichem's strongest competitor was a large U.S.-based chemical company whose only plant for making a close substitute for Release-ease was located in Luxembourg. Its sales in Europe were strong and it made some export sales to the U.S. and Latin America. But Applichem had by far

the largest market share and the mystique associated with having patented the earliest available form of the product. A third U.S.-based company provided some competition in the U.S. but J. (John) Benfield, who was Operations Manager for the Plastic North American Business Team in 1982, said that he thought that the latter company was not seriously committed to the business for the long run. They had a plant with some excess capacity, and in 1982 they were using it to produce another close substitute for Release-ease.

In Japan, Applichem was the only company whose product had been approved by the regulators. Joe Spadaro said that eventually there would be some other products sold in Japan, even if only exports from Europe. And the Plastics Operations Manager of the Pacific Area told the casewriter that he had heard that someone in the Japanese government had been approached with the idea of approving a Release-ease-type product.

Company Background

Applichem was a manufacturer of specialty chemicals founded in Chicago just before World War II. Most of its products were devised by Applichem's applications engineers as solutions to a specific customer's problems. Applichem's Research department subsequently refined the product and process—in successful cases—to arrive at a product with broader application.

Applichem had a strong functional orientation, even though some matrixing had been introduced to the organization during the mid-1970's. There is evidence of matrixing in the June 1982 organization chart presented in *Exhibit 1.* There were Business Managers for two businesses reporting to a Group Vice President and four Area Vice Presidents reporting to the Chief Operating Officer. Each Business Manager led four business teams, one for each of the four Areas. Each Area business team was headed by one full-time manager. On each team were a financial manager, a marketing manager, an R&D manager (who usually focused on new product introductions) and an operations manager. The functional managers also held line jobs in their respective Area organizations. The operations and marketing managers, like employees in the manufacturing plants and sales and marketing organizations, reported up through the Area organizations. Finance and R&D reported up through the functional organizations. For example, John Benfield, Operations Manager for the Plastics North America Business Team in 1982, reported through two boxes on the organization chart in *Exhibit 1:* directly to Joe Spadaro and through several people to the Vice President of the North American area.

Technology

Release-ease was manufactured by a 4-step process. In the reaction step the raw materials (several of which were hazardous, flammable, and therefore not transportable internationally) were combined in a precise sequence under pressure and heat to form the Release-ease. The Release-ease was then precipitated out to form a slurry. The timing of introducing materials into the pressurized vessel (or kettle)—as well as the temperature and pressure which prevailed, the feedrates, heat removal, and agitation—affected the size and composition of the forming Release-ease particles. The quality of the Release-ease, the amount of raw materials, and the characteristics of the process were unaffected by the source of energy used in the plant. So steam, natural gas, oil and electricity were combined differently at different plants to minimize local cost.

The second step was to clean, or isolate, the Release-ease particles from the slurry. This was done by moving the slurry on a conveyor belt made of mesh so that the liquid fell through the belt to the trough below, leaving wet Release-ease particles on the belt. In the third step, Release-ease particles were dried; and in the fourth step the Release-ease powder was packaged in bags on an automated filler line.

Laboratory samples were taken for analysis at the end of the reaction, cleaning and drying steps. It usually took four hours for operators to get the laboratory results. Since waiting between the cleaning and drying steps impaired product properties, Release-ease particles moved continuously between cleaning and drying. The information was used to classify the material after it was processed. Material that was off-spec was reworked in some plants; in other plants some of it was reclassified as QC-3 (QC-1 was the category for product which conformed to specs) and sold for a lower price.

Throughout the process there were possibilities for yield loss. For example, in the reaction step some of the raw materials were added in powder form, and they could be lost as dust on the floor and in the air. In the cleaning step, particles might be filtered out with the liquid and impurities. Recapturing waste materials was an important source of yield increases; the manufacturing people typically improved recapture gradually over years of work. Waste could also be an important health and safety measure.

The average yield of Release-ease on raw material A was a key indicator of the overall performance of the Release-ease manufacturing processes at different plants. The yield was defined by dividing the actual number of pounds of active ingredient in the final product by the number of pounds of active ingredient which would be in the Release-ease if all the key raw material A were converted to active ingredient. Yields were usually expressed in percentages. Benfield explained, "Plants designed for larger volumes of output generally have higher yields. Raw material A might not wind up in the final product for one or both of two reasons. (1) There might be physical losses (waste) during the process. For example, raw material A per pound of Release-ease left in a drum container (used in low volume processes) would be greater than that left in a railroad tank car (used in high volume processes). (2) The available raw material A might not be converted during the process. Larger scale processes would have less waste than smaller scale processes. But the proportion of available raw material A converted to Release-ease would be determined by how well the process was run, regardless of scale. A well-run, low-volume (around 5 million pounds a year) process would have an average yield on A of 91 or 92 percent; a well-run, medium-volume plant would have an average yield on A of 94–95 percent; a well-run, high-volume plant would have an average yield on A of 98–99 percent."

Usually, the manufacturing process was run 24 hours a day, 7 days a week. This was because shutting down the process required expensive cleaning of the reaction kettles and the driers where Release-ease particles stuck. Similarly, changing the size of bag in the packaging line frequently took a day.

One of the main quality measures for the final product performance was the percent of active ingredient in the powder since high active ingredient correlated well with good application properties, especially for U.S. markets.

The Plastics North America Business Team estimated that in 1982 it would cost about $20-25 million to build another plant like that in Gary, Indiana. And they expected that the plant would have a useful technical life of about 20 years if properly maintained.

The Manufacturing Plants

The *Gary* plant was managed by the North American Area. It supplied Release-ease to customers located in that Area. The plant was located in Gary, Indiana, (just outside Chicago) and in a neighborhood where immigrants from Eastern Europe had settled during the early twentieth century. The plant was founded in 1905 and purchased in 1951 by Applichem as the company's first. large manufacturing facility. Many people who worked in the Gary plant in 1982 had followed 6 to 10 other members of their families who had worked there over the generations. They were loyal to the

plant and to the plant manager, who had grown up in the neighborhood and called himself the "Gary kid."

Release-ease was the first product Applichem manufactured there, and the process had changed incrementally with the market for Release-ease. Most equipment for the process used in 1982 had been installed between 1959 and 1964. It was designed to run a wide range of product formulation and package types. In 1982 Gary ran 8 formulations of Release-ease and about 80 package sizes, while the Frankfurt plant, for example, ran only 2 formulations of Release-ease and one 50-kilo package.

The plant manufactured 19 product families in addition to Release-ease. It had a total of 1,000 non-union employees, down from about 2,000 during the mid-1960's. It had a Release-ease design capacity of 18.5 million pounds a year, and around 60 people manufactured 14 million pounds of Release-ease in 1982.

The *Canadian* plant, located in Southern Ontario, had been started up in 1955. It was managed by Canadian nationals who reported to the North American Area. It had a non-union work force. And in 1982 it supplied four products in addition to Release-ease.

The plant was generally well-regarded within Applichem for its efficiency and the quality of its product. It had a "no-frills" design and had been well-maintained since its inception. It had a rated annual capacity of 3.7 million pounds of Release-ease and it manufactured 2.6 million pounds of Release-ease in 1982. It supplied Release-ease only in 50-kilo packages.

The *Frankfurt* plant was managed by German nationals who reported through the European Area, and it supplied customers located in Europe, the Middle East, and Africa as well as other Applichem plants. It made 12 product families in addition to Release-ease. The plant had 600 employees in 1982. It made about 38 million pounds of Release-ease a year in 1982, and its design capacity was 47 million pounds a year. It had two processes for manufacturing Release-ease: one installed between 1971 and 1974 and one installed in about 1961, with later major modifications to increase capacity. The processes featured computer control of the first process step and extensive solids recovery and waste treatment. Frankfurt bulk-shipped Release-ease to other company plants which then packaged it and shipped it to customers.

Release-ease manufacturing was managed by Ari Pappas. He was a Greek national who had headed Release-ease manufacturing at Frankfurt since the mid-1960's. He had got to know Joe Spadaro and several other members of Applichem's top management team when they had worked in Europe during the sixties. Pappas had a technical bent, and he had worked with customers, the Applichem Technical Center in Europe, and his own employees to improve the yields and reliability of the Release-ease he made.

The *Mexican* plant was part of a wholly owned subsidiary of Applichem. It was managed by Mexican nationals, who reported to the vice president of the Latin American Area. It supplied the Mexican market and in the early 1980's the Far East. The plant processed about 17.2 million pounds of Release-ease during 1982, and had a design capacity of 22 million pounds a year. All its Release-ease was packaged in 50-kilo bags. The process had been installed in 1968 with extra drying capacity introduced in 1978. It was similar in design to the Gary plant, and manufactured 6 product families in addition to Release-ease.

The *Venezuelan* plant was started up in 1964. It had a "no frills" design, and no improvements had been made between 1964 and 1982. Its rated annual capacity was 4.5 million pounds, and it produced 4.1 million pounds of Release-ease in 1982. Its Release-ease was packaged only in 50 kilo bags. The plant had old equipment and the only dryer was in poor repair. It was managed by

Venezuelan nationals, who reported to the vice president of the Latin American Area. And it manufactured one product family in addition to Release-ease.

The educational levels of the Mexican and Venezuelan operators were significantly below those of operators in the other plants. John Benfield explained that the Mexican operators had some technical depth and were able to maintain process improvements suggested by Ari, while the Venezuelans were not. The Venezuelans had not improved process yield or capacity.

Sunchem was Applichem's 50% Japanese joint venture in Japan which owned and operated a manufacturing plant for Release-ease and one other product for the plastics industry. It was managed by Japanese nationals and reported to Applichem's Pacific Area. It was founded in 1957 and had supplied the Release-ease requirements of Japanese customers after that. The process had been redesigned in 1969. Some automation and waste recovery had been introduced. Its volume was constrained by low dryer capacity in 1982. The Japanese plant processed many ½-kilo and 1-kilo packages. The plant had a rated capacity of 5 million pounds a year, and it produced 4 million pounds in 1982. Within Applichem the Japanese plant was generally thought to be technically excellent. Employees there did more development work than the other plants: they had a product test laboratory, a plastics engineering lab and a workers' dormitory for single men. Japanese managers said that they required more environmental protection measures than the other plants. Theirs was, for example, the only plant with scrubbers for processing gaseous wastes.

There was no union at this plant although there generally were industry—as opposed to company—unions in the Japanese chemical industry. In 1979 the plant manager wrote to U.S. management to explain why an unusually large number of employees was needed in Japan relative to similar Applichem plants elsewhere. He wrote:

> Work rules and regulations seem to be more severe than those in other countries. For example, the Japanese Fire Prevention Law prescribes that the work of handling flammable raw materials must be performed by those having a license for doing such work. Among the works requiring similar licenses—there are those of wide variety in which we handle high-pressure gas as in refrigerators, toxic substances, organic solvents, and drying works being performed where oxygen is not sufficient. A number of plant operators will have to attend training courses to acquire such licenses....
>
> We know that one operator has been taking care of running of several kettles at the Gary plant. Only one operator would not be enough to handle all kettles here because our workers do more work with the kettles....
>
> In accordance with a strong recommendation by the Shift Work Committee of the Japan Industrial Hygiene Institute, manufacturers are required to allow a temporary sleeping time for two hours a day to all who are engaged in mid-night works.

The Cross-Plant Productivity Study

John Benfield had managed the study comparing productivity at different plants. Talking in retrospect about it, he said:

> The report got things on an even keel. It set the agenda. Until then our report managers at one plant rarely encountered managers from sister plants. And they never gave much attention to improving their process on the basis of what other plants had done.

> While the standard costs and volumes of Release-ease were easily available for each plant, the technical information needed for the Study was not available. Allocating indirect labor over products was a major problem. The Japanese and Gary employees, for example, complained throughout that they simply had low volumes which caused their overhead to be too high. Yield information was available, but only the technical people in the plants had it. The Study was able to identify precise labor productivity differences among plants and to set an agenda for improvement.
>
> It was important that financial and technical people in all the plants worked together developing the numbers. We argued back and forth during the process, trying to ensure that everyone in the plants agreed with the numbers. For example, to satisfy some concerns at Gary, where a lot of time was spent packaging Release-ease in small packages, packaging was studied separately for all plants. And the Japanese over-estimated their material usage in their standards because they did not want to be caught short. So we took their usage numbers from their actual experience year-to-date.
>
> Over the 4 months that we worked on the report before it was published in September 1982, probably 4 man-months went into it. The individual plants were not interested in repeating the comparison project. In fact, some said that they hoped it was never done again. It was a pain.

Exhibit 2 presents the breakdown and comparison of manufacturing costs for Release-ease at Applichem's six plants in 1982 as it appeared in the Study. *Exhibits 3* through *6* present some of the data which Benfield's group used in defining and computing the cost figures presented in *Exhibit 2.* The costs in *Exhibit 2* are manufacturing, as opposed to delivered, costs. Annual volume of Release-ease was a plant's forecast volume of Release-ease for 1982. Indirect costs were allocated over all the products in each plant; the standard cost of Release-ease included the allocated indirect costs. The operating costs were derived by dividing a plant's annual budget for the corresponding element of expense for all Release-ease production by the annual volume. Raw material prices and exchange rates were those used in the plants' 1982 business plans. Benfield said,

> Although exchange rate changes have a significant impact on comparative raw materials costs stated in dollars, the impact is lessened due to the fact that more than half of the raw materials are available in competitive international markets. We estimate that over the long haul only 30 to 40 percent of the raw material cost is directly influenced by exchange rate changes. A variety of energy sources are used by the plants depending on local price and availability. We expect the overall utility costs per pound of Release-ease to continue to be roughly equivalent for all plants except Sunchem where high local electricity costs reflect Japan's generally high energy cost.

Two employees from the Gary plant spoke with the casewriter about the study. T. E. (Tom) Schultz was a project manager in development engineering at the Gary plant when John Benfield was assembling the productivity study. He had joined Applichem in 1978 just after completing his Bachelor's degree in Chemical Engineering. And in the period before Applichem's U.S. Controller took over, Schultz and Gary's Production Manager for Release-ease began work to improve productivity in the Release-ease area. By the time John Benfield requested information for the Productivity Study, they had it close to ready. The entire process of getting the data ready for the Study took about 2 man-years. But Schultz had been enthusiastic about the study because he had believed that corporate managers were seeking to identify the best process ideas from all the plants and to implement them wherever they were relevant throughout the Applichem manufacturing network. Tom Schultz said:

There were several difficulties in comparing cost, usage and yield statistics across plants—even data assembled as carefully as Benfield did. For example, the Gary plant was designed to manufacture prototype samples for customers, and most products in the Release-ease family had first been manufactured in Gary. Also, being an old product, Release-ease has folklore in Gary. There was also a body of opinion to the effect that older product [greater than two years] suffered some degradation in applications performance. As it was not unusual for product in the U.S. to be in the distribution channel for two years, Gary placed great emphasis on achieving high A.I. at time of manufacture. We were also very leery about implementing some of the changes that the Frankfurt plant had made because we were afraid that our product shelf life might be adversely affected. As Frankfurt's product stayed in the distribution channel for at most one year, their emphasis on high A.I. product was less than ours and they were more adventuresome in adopting process changes.

You know, when I joined the Gary plant it seemed that we had the lowest costs of any plant. But then the exchange rates changed a lot. And the productivity study came along just when we looked bad... I wonder when the exchange rates will swing back and make Gary look good again.

W. C. (Wanda) Tannenbaum was Financial Analyst at the Gary plant during the Productivity Study. She had joined Applichem in 1981, after completing an undergraduate degree in Business from the University of Illinois. She noted that the study was very technically oriented, that she was involved only to "look it over." She explained:

At Applichem we use fully allocated standard costs for operations management. For sourcing we used out-of-pocket costs. The data needed for the Study were available, but not in accessible form. For example, we had many monthly reports, but no data was cumulative. And standard costs were redefined only once or twice a year, so it was just about impossible to get actual costs for Release-ease by month.

In Finance we did a lot of computer work to get the reports we wanted. In fact, we installed an Apple III in 1982, the first PC [personal computer] in Applichem.

The allocation of indirect costs was a big problem for the Study—especially for a plant like Gary. It was not designed to be a real streamlined operation. It was designed to be a batch operation for research and specialty products. Its equipment is unique. It is spread out all over the place. You just can't compare it with plants that make commodities.

Exhibit 1 Organization Chart, June 1982

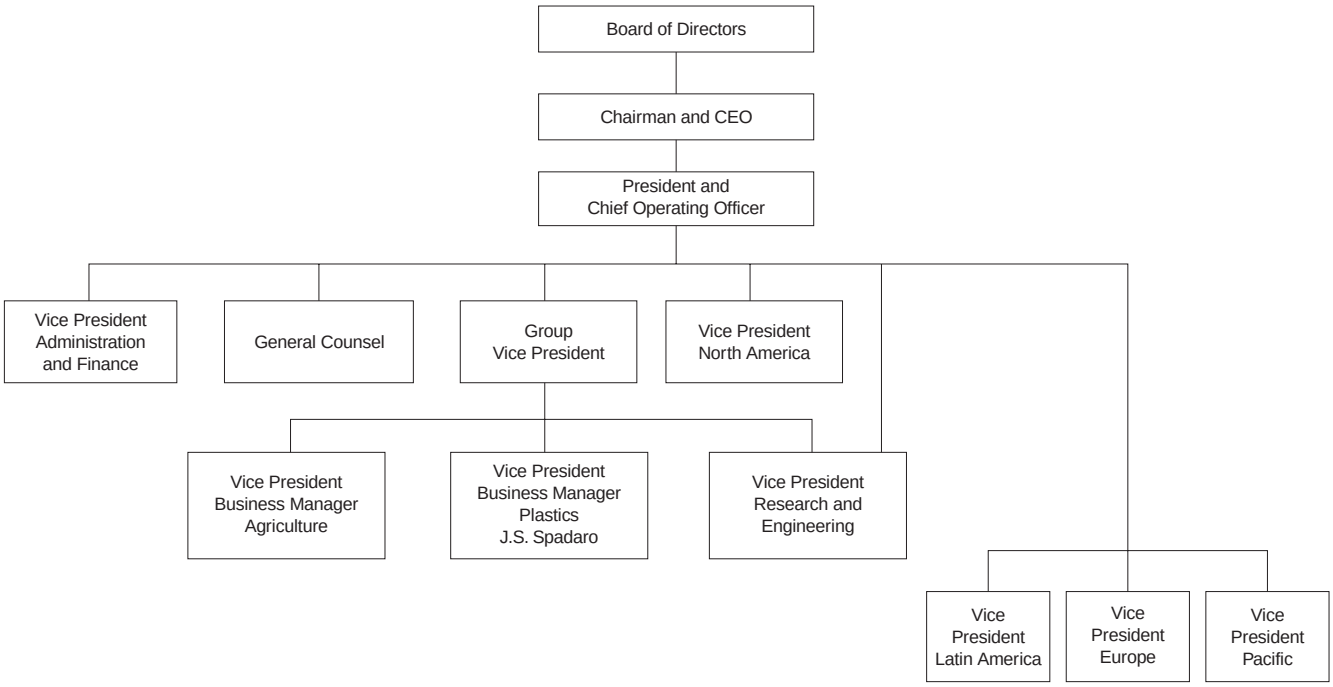

Exhibit 2 Comparison of Worldwide Release-Ease Manufacturing Cost
(U.S. dollars per hundred pounds of Release-ease)

	Plants					
Expense	**Mexico**	**Canada**	**Venezuela**	**Frankfurt**	**Gary**	**Sunchem**
Raw Materials						
A	27.00	28.32	24.67	24.02	27.96	29.62
B	14.57	15.26	26.82	11.69	13.52	20.41
C	16.39	11.19	19.18	9.03	6.92	24.68
D	5.89	7.45	9.52	3.75	6.48	5.50
Other	11.20	6.48	7.10	4.51	5.95	11.65
Subtotal	75.05	68.70	87.29	53.00	60.83	91.86
Raw Material						
Overhead	—	—	—	—	2.65	—
Operating Costs						
Direct Labor, Salary & Fringes	2.38	7.03	4.68	5.78	8.46	12.82
Depreciation	.95	.97	.94	1.05	1.60	3.23
Utilities	5.08	5.50	5.96	5.54	5.45	10.49
Maintenance	1.60	2.75	2.17	1.34	3.71	3.77
Quality Control	.64	1.30	1.81	.57	1.54	2.77
Waste Treatment	1.37	.96	—	.64	1.02	10.61
Plant Administration	1.11	3.62	4.58	2.91	1.22	4.07
Development	—	—	—	.38	.97	2.48
Supplies	2.25	.98	3.65	—	.77	.56
Building Expense	—	—	—	1.12	.64	.36
Other	2.20	1.44	1.23	1.01	.29	6.22
Subtotal	17.58	24.55	25.02	20.34	25.67	57.38
Subtotal: Cost Before Packaging	92.63	93.25	112.31	73.34	89.15	149.24
Package, Load, & Ship	2.38	4.10	4.03	3.35	13.78	4.56
Total Cost	95.01	97.35	116.34	76.69	102.93	153.80

Notes:

1. Operating costs include indirect labor and associated material costs other than raw materials.

2. Raw material overhead in the Gary plant included incoming inspection, handling, and inventory carrying costs related to raw materials. For other plants those costs were included in Operating Costs.

Exhibit 3 Number of People at Each Operation at Each Plant

	Plants					
	Mexico	**Canada**	**Venezuela**	**Frankfurt**	**Gary**	**Sunchem**
Direct Labor						
Reaction	5.5	3.1	3.4	13.9	6.3	5.0
Clean	1.8	2.0	1.7	11.8	2.5	3.4
Dry	1.8	2.0	1.7	5.6	3.6	3.4
Package	10.4	5.0	6.2	14.6	11.3	2.7
Subtotal	19.5	12.1	12.9	45.9	23.7	14.4
Indirect Labor						
Maintenance	5.6	2.0	1.5	14.6	6.4	.3
Quality Control	1.8	2.1	1.8	4.9	3.2	2.4
Production Supervision	2.1	1.6	.6	7.3	3.4	2.5
Plant Administration	3.1	3.7	4.3	NA	1.5	3.4
Development	.6	—	—	1.7	2.2	3.2
Waste Treatment	1.8	1.4	—	.8	.1	2.5
Utilities	1.3	1.0	1.3	2.8	1.1	.8
Raw Materials Handling	—	.6	—	2.4	4.1	—
Shipping	3.1	1.9	1.5	5.7	9.2	—
Miscellaneous	5.5	1.3	—	NA	3.4	1.5
Subtotal	24.9	15.6	11.0	40.2	34.6	16.6
Total	44.4	27.7	23.9	86.1	58.3	31.0

Exhibit 4 Miscellaneous Information

	Plants					
	Mexico	**Canada**	**Venezuela**	**Frankfurt**	**Gary**	**Sunchem**
Utility Usage (per million pounds product)						
Steam (metric ton)	2.09	3.06	NA	3.18	2.74	NA
Natural Gas (cubic meter)	—	84.31	277.20	—	78.40	—
Oil (liter)	98.00	—	—	74.20	—	214.20
Electricity (kilowatt hours)	298.20	360.12	387.8	245.00	344.40	463.40
Utility Costs ($ per unit purchased)						
Steam (metric ton)	25.00	19.50	5.21	20.56	23.43	NA
Natural Gas (cubic meter)	—	.12	.05	—	.18	—
Oil (liter)	.32	—	—	.35	—	.31
Electricity (1000 kilowatt hours)	40	40	71	45	56	79
Raw Material Usage (lb/hundred pounds of Release-ease)						
A	20.04	19.53	19.27	18.9	20.75	19.14
B	51.21	51.15	50.60	47.82	53.8	48.23
C	55.97	50.96	52.00	50.28	53.6	49.49
D	26.40	26.09	26.00	24.21	28.77	25.07
% Active Ingredient (A.I.) in Product as Shipped						
Average A.I.	85.6	84.7	NA	84.4	84.6	85.4
Average Yield on Raw Material A (Percent)						
$\frac{\text{Actual Pounds A.I.}}{\text{Theoretical Pounds A.I.}} \times 100$	94.7	91.1	91.7	98.9	90.4	98.8
Volume (million pounds)						
Annual Production Volume in 1982	17.2	2.6	4.1	38.0	14.0	4.0
Annual Design Capacity	22.0	3.7	4.5	47	18.5	5.0

Exhibit 5 Transportation Costs Among Plants (¢/pound)

FROM/TO	Plants					
	Mexico	**Canada**	**Venezuela**	**Frankfurt**	**Gary**	**Sunchem**
Mexico	0.0	11.4	7.0	11.0	11.0	14.0
Canada	11.0	0.0	9.0	11.5	6.0	13.0
Venezuela	7.0	10.0	0.0	13.0	10.4	14.3
Frankfurt	10.0	11.5	12.5	0.0	11.2	13.3
Gary	10.0	6	11	10	0.0	12.5
Sunchem	14.0	13.0	12.5	14.2	13.0	0.0

Notes:

(1) It cost 11¢ to transport a pound of Release-ease from Canada to Mexico and 11.4¢ to transport a pound of Release-ease from Mexico to Canada. The price of transport depended on distance, type of transport and the volume transported. Where there were differences in transport costs between two locations, they were due to diffences in the volumes Applichem had historically shipped in each direction between the locations.

(2) These costs exclude duty into each country. In 1982 the duty into each country was the following percent of the value of Release-ease imported:

Mexico	**Canada**	**Venezuela**	**Germany**	**U.S.**	**Japan**
60%	0%	50%	9.5%	4.5%	6%

Exhibit 6 History of Exchange, Inflation, and Wage Rates

	Country					
	Mexico	**Canada**	**Venezuela**	**Germany**	**U.S.**	**Japan**
Average Annual Exchange Rates: (currency/$1 U.S.)						
1982	96.5	1.23	4.3	2.38	1.0	235.0
1981	26.2	1.18	4.3	2.25	1.0	219.9
1980	23.2	1.19	4.3	1.96	1.0	203.0
1979	22.8	1.17	4.3	1.73	1.0	239.7
1978	22.7	1.19	4.3	1.83	1.0	194.6
1977	22.7	1.09	4.3	2.10	1.0	240.0
	(Pesos)	(Canadian Dollar)	(Bolivares)	(Deutsche Mark)		(Yen)
Average Annual Price Indices (1980 = 100)						
1982	194.2[a]	116.8	123.0[c]	114.1[b]	113.7[b]	103.2[a]
1981	124.4	110.2	113.8	107.8	110.6	101.4
1980	100.0	100.0	100.0	100.0	100.0	100.0
1979	80.3	88.1	83.3	93.0	86.1	84.9
1978	67.9	77.0	76.3	88.7	76.3	79.1
1977	58.6	70.5	71.0	87.7	71.0	81.2

[a]Wholesale prices

[b]Industrial prices

[c]Home and imported goods

Source: *International Financial Statistics,* International Monetary Fund.

Average Gross Money Wages (Before Income Taxes, Social Security Contributions, and Benefits) (local currency per hour)						
1982	99.42	10.25	14.37	14.64	8.50	1424.86
1981	63.46	9.17	13.08	13.92	7.99	1372.77
1980	48.11	8.19	11.26	13.18	7.27	1292.66
1979	39.91	7.44	10.42	12.36	6.69	1203.80
1978	34.17	6.84	9.88	11.73	6.17	1134.00
1977	29.70	6.38	8.74	11.14	5.68	1061.00

Source: Business International Corporation, *Worldwide Economic Indicators,* One Dag Hammaoskjold Plaza, NY, NY. The values for Venezuela were estimated by John Benfield using Applichem sources because the complete series was unavailable in *Worldwide Economic Indicators* .