FINAL REPORT for PROJECT XL at MOLEX

The intent of the Project XL at the Molex, Lincoln, Nebraska facility was to demonstrate the environmental and economic feasibility of segregated wastewater treatment verses non segregated. Data was collected from the last three years of operating Molex's non segregated wastewater treatment system. This data will be used when comparing the results of running the newly installed segregated wastewater treatment system. Data has been collected for the two years of the project.

Molex was issued variances for the primary purpose of improving the economic viability of the project. In return for these variances, improved environmental results were expected.

The goal of the project is to demonstrate that environmental excellence can be achieved while reducing the costs of the environmentally impacting activity.

The technical aspect of the project is to prove the concept that treating each metal separately will make it possible to have the optimum pH, prefloc, and flocculant needed to produce the lowest solubility of the metal being treated. Each metal has optimums that are different. Because of this, it is assumed that removal of all metals can not be optimized in a treatment system when all the metals are treated together. The technical problem is to separate (not mix the waste streams) and treat each in separate systems. This requires additional equipment which results in additional costs up front and possibly increasing operational costs as well. Hopefully, these costs can be effectively offset. Since the sludges produced are basically mono-metallic, they have significantly more value because they can be more cost effectively recovered than the mixed metal sludges.

The business climate has been excellent and our facility has experienced very significant production increases during the two years of the XL Project. We keep production records and will use them as needed to weight other measureables.

This increase in production has had a very positive effect on the results of the project. It has resulted in increasing the savings numbers, which has helped to make this project more financially successful than originally expected.

It is not possible to make direct comparisons in some cases because of the changes in equipment and practices. One can only estimate what costs would have been incurred in today's environment using a non segregated system like what we had previously.

Sludge generation under the old scenario would have been half (due to sludge drying) the current volume of nickel, copper, and 40% of the tin sludge (old system ran the tin rinses directly to effluent discharge) . Sludge drying was very labor intensive, environmentally unhealthy, and expensive. Now that most of the sludge is hydrometallurigically treated, drying has happily eliminated with the new system.

For comparisons, the costs to operate the old system at today's production levels were estimated. The last year of operation (July 1995 - June 1996) against this last year production (August 1999 - July 2000) will be used to factor costs associated with sludge drying.

Production for July 95 - June 96 was 2544 MM circuits. For August 99 - July 00 production was 4140 MM circuits. This is a 62.7% increase or 1.627 production ratio increase. This number will be used in adjusting the costs for comparison.

Chemical, electrical, and labor will not be compared for the following reasons. Chemical usage is not an issue because the basic treatment is the same: pH adjust, flocculation, precipitation, and sludge compacting. The cost associated with these steps would have been the same with the old system since we would have had to treat the same amount of acids, bases, and metals. Electrical is very similar since the pumping and mixing that is required would be the same with both systems. Labor is very similar, we have never assigned anyone specifically to the operation of the system. We have eliminated the labor associated with sludge drying but feel the labor costs are very similar with the unsegregated system. These costs are lower but much of this is due to the automation that was a part of the new system design.

The main areas for savings are from drying sludge, and sludge processing.

We generated the following quantities of sludge the last year of the XL Project: 35,200# copper, 60,694# nickel, and 16,614# tin. If we had been using an unsegregated system as before, the total sludge generation would have been as follows. 35,200 + 60,694 + (.4 X 16,614) all divided by 2 since the drying process reduced the weight by 50%. This would have yielded a total of 51,279 # of mixed sludge. We had to pay $ .50/ pound to process sludge and received about $.60 a pound for the net copper (this is about 14% of the copper sludge weight). This means we would have paid $25,635 and received $2,957 for a net lose of $22,678.

The cost to dry sludge (power and equipment, and not labor) the last year was determined to be $9,000. With the 62.7% increase in production, this cost would have resulted in a cost of $15,030. Transportation would have been $3,400 for two truck loads @ $1700 each. Our current sludge processors provide the transportation and it is deducted from the net return which will be covered later in this document.

The net savings (cost avoidance) from sludge processing, drying and transporting would have been $41,108 this last year. It was less the first year of Project XL, but will be even higher as production continues to increase. During our fiscal year 00 (July 99 - June 00) our average net return for metals recovered was $351/month for a total savings of $4,212. This and the $41,108 in avoidance totals $45,320/ year improvement over unsegregated treatment technology.

We originally spent an additional $150,000 to install a segregated system as opposed to a non-segregated system. Originally we'd hoped the payback would be 7 years. The current payback rate is 3.3 years. This rate was not as good the three earlier years, but will be higher in the future. This is due to production changes.

In light of these numbers, one would have to concluded that financially this has been in the best interest of Molex.

The Quest for Environmental Excellence

The improvements in effluent quality have been very significant. The average concentration of metals is much lower. We did have several excursions early on due to design problems and training issues. These have been addressed and since

then no excursions have occurred. Here is the data from the last year of operation for the old unsegregated waste water treatment system.

Average concentrations for last year of operation.

DMR Analysis Data	Metal	City Analysis Data
0.76 mg/l	copper	0.83 mg/l
0.89 mg/l	nickel	1.48 mg/l
0.043 mg/l	lead	0.12 mg/l
0.25 mg/l	zinc	0.25 mg/l
<.01 mg/l	cadmium	0.0007 mg/l
ND(none dedected)	chromium	0.007 mg/l
ND	silver	0.001 mg/l
ND	total cyanide	0.017 mg/l

Average concentrations during Project XL

DMR Analysis Data	Metal	City Analysis Data
0.195 mg/l	copper	0.603 mg/l
0.380 mg/l	nickel	0.748 mg/l
0.070 mg/l	lead	0.102 mg/l
0.060 mg/l	zinc	0.124 mg/l
ND	silver	0.075 mg/l
ND	cadmium	0.005 mg/l
ND	chromium	0.004 mg/l
ND	total cyanide	<0.01 mg/l

The issue of Total Toxic Organics (TTO) is not being addressed here for several reasons. First, the waste treatment systems do not treat or remove them from the effluent. Second, we have never had any significant quantities present. Third and finally, control of TTO must be controlled by insuring they are not used in any processes connected to the water treatment system. It is by nature a prevention process and not a treatment process.

Improvement in the effluent concentration of the major metals has been significantly improved. The average daily concentrations are very much improved, but several excursions exagerated the results. Lower metal concentrations can definitely be obtained treating metals separately. In our case,

copper and nickel, the two biggest quantities used are hydrometallurgically treated. This has significant environmental benefit also. All the major metals are now being recycled. We had dischrged the tin from the pure tin processes previously, but now it is all removed and recycled. This greatly reduces total dissolved solids and conserves natural resources.

Conclusion

In light of the results of the project, I feel it has been a success and can be a win-win situation if the principles are applied (and similar variances granted) throughout the plating industry. Unfortunately, retrofitting systems is far more difficult and expensive than new installations. In the future, new facilities should be strongly encouraged to treat metals separately wherever possible. This was very much a learning process. Treating metals separately can be difficult in some cases and very easy in others. It must be kept in mind there are opportunities to improve on what we have accomplished here. How the results of this endeavor can be shared throughout the industry is an issue that can be addressed in the near future. It was a long and arduous journey but the experience was worth the effort.

I especially appreciate the efforts and contributions made by EPA Region VII, Nebraska Department of Environmental Quality, and the Lincoln Theresa Street POTW staff. Without their efforts, this project would have never became a reality. Thanks to everyone involved.

Sincerely,

Paul Eckerson, Molex

Lincoln, Nebraska.

PROJECT XL COST AVOIDANCE & INDIRECT SAVINGS

In the initial final report, some of the costs that are the result of the variance were not considered. Without the conditions of the variance allowing longer periods of time for storage and the listing of the sludges as hazardous material and not hazardous waste, costs would be significantly higher.

By segregating waste streams for separate treatment, several sludges instead of one are produced. For processing they are sent to different facilities for processing. This would have required additional shipments by hazardous waste haulers. These rates are much higher than common carriers. None of these shipments would have been full trucks making the cost per pound shipped very high. Due to the fact all the metals are segregated, there is no precious metal in the 99% + (by weight). Therefore the 270 exclusion rule would not apply. That means we would have gone from 2 shipments per year (full trucks) by hazardous waste haulers to 12.(partially full trucks). This is another form of pollution...inefficient use of energy.

The full trucks cost $1700 times 2 equals $3400 per year in shipping costs. The partial trucks cost $1400 times 12 equals $16,800. This is a savings of $13,400 and an untold amount of fuel and carbon dioxide emissions.

The other significant avoidance in cost comes from the fact we would be large quantity generators. By not having to count the recycled materials as wastes, we avoid the large quantity generator status and all the costs associated with the additional compliance requirements. (training, record keeping, reporting, audits, etc.) I assume this costs the government additional moneys as well. What this cost avoidance is cannot be calculated. $5000 to $10,000 is a good educated guess.

Another issue is reduced environmental impact. Due to our segregation, the metals are recycled by more environmentally friendly methods. The copper and the nickel are now recovered hydrometalurgically as opposed to incineration.

Unsegregated Wastewater Treatment Used By Molex Previous to the XL Project

This system treated all the wastewaters (except the rinses from the electrocleaning rinses, the tin rinses, and the cleaners when they were dumped) together.

The cleaner and its rinses were not treated as they contained metals below discharge limits and tin is not regulated. The were divereted directly to the final neutralization station. Here they were mixed with the treated effluent and discharged to the local POTW.

The wastewater treatment system was a standard two stage pH adjustment, flocculation, lamella settler, sand filter and final pH adjust system.

The sludge was removed fom the lamella by automatic controls to a sludge thickening tank. The sludge was pumped into a filter press and the resultant filter cake was dried from 50% moisture to 20%.

The filter cake (sludge) contained significant amounts of gold, because of this it qualified under the "270 exclusion rule". It was sent to a copper smelter/refiner for recover of the metals. Molex was charged $.50/pound to process this material. Shipping cost was $1700 per truck load. Molex received moneys for the copper and gold contained in the filter cake. The value of these metals (less fees) was calculated. The refining cost (.50 x total weight of filter cake processed) was deducted from the value of the recovered metals. The remaining money (gold) was transfered to our gold supplier who reprocessed the gold and ultimately was reused in our plating operation. The net effect of this system was to use the value of the gold to cover the cost for the treatment of the other metals.

The intent of the segregated system was to recover all of the gold in a separate system and for the remaining metals to be recovered as cost effectively as possible. Hopefully the additional costs incurred with the segregated system would be more than offset by the savings from the reduced cost (increased revenue) from the treatment and recovery of the base metals.

The effectiveness of this treatment system was monitored by the city and by outside analysis to meet the the DMR reporting requirements. The results for the last full year (June 95- June 96) are as follows:

Average concentrations for last year of operation.

DMR Analysis Data		City Analysis Data
0.76 mg/l	copper	0.83 mg/l
0.89 mg/l	nickel	1.48 mg/l
0.043 mg/l	lead	0.12 mg/l
0.25 mg/l	zinc	0.25 mg/l
<.01 mg/l	cadmium	0.0007 mg/l
ND(none dedected)	chromium	0.007 mg/l
ND	silver	0.001 mg/l
ND	total cyanide	0.017 mg/l
0.0058 mg/	total toxic organics	Not analysed