A Multi Disciplinary Approach to Ink Recycling

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Abstract:
Reclamation and recycling of printing consumables has become of paramount importance to the well-being of the printer both legally and in the minds of their customers. This paper describes a multi-disciplinary approach to efficient in-house reclamation of printing ink that not only can reduce ink consumption by ten percent, but also pay for itself by practically eliminating waste disposal.

The last few years have netted some profound changes in the way industry conducts business. This is particularly true in the area of environmental responsibility and the management of the complex and often confusing regulations governing this field. It is paradoxical but almost all new technology and processes being developed in graphic arts, although certainly engineered to reduce waste and to simplify the operators handling of the process itself, still do produce waste. It is now frequently hidden behind the clean, sleek, boxed in facade. (Certainly the drain is not on the front of the unit). Thus it is frequently ignored or dismissed until a major problem or inspection takes place.

Printing ink is no exception to this concern. Despite the hype and promotion of the marketing departments of ink companies I believe ink truly is fulfilling its function in the process only when it is invisible. Invisibility in this

context is defined as ink only being located where it is supposed to be. Modern high speed presses now have their ink delivered to them from tanks or tote bins which are enclosed. Once connected to the pump system the ink is fed to its appropriate fountain that is in turn controlled remotely from a console where a press manager adjusts necessary inputs by looking at or scanning the printed result. He rarely in fact goes near the fountain. If the image is satisfactory and can be maintained the ink is "invisible". It only becomes visible and thus ink when it ends up where it is not supposed to be. This necessitates adjustment either by the printer or the inkmaker but, once made it again descends to invisibility. Misting, piling, dampener feedback and rub off are all manifestations of this visibility/invisibility concept.

Where this scheme of things breaks down is with what is left at the end of the run. Waste or excess ink has to be handled safely, economically and effectively. It has been our experience that this is rarely so. In the two years we have worked on this project my staff and I have found that handling waste and excess ink ranks right behind non-anaesthetized tooth extraction in popularity. Most plant visits unearth a room or an area that contains huge quantities of material that will frequently date back to the dawn of aluminum printing plates. A slight exaggeration, but not much.

Not only is there no program to manage this ink but often we find that the process of collection and storage is part of the companies lore and is the responsibility of no one until the "inspection". At that point hysteria takes hold and what takes years to accumulate now has to be disposed of in days; hours preferably. In the past the process has involved incineration, the

ink company "taking
it back" or plain illegal dumping. Although incineration remains an option, the other two do not. Thus the only reasonable alternative is for the printer to handle it in house. Based on this premise we undertook a project to develop a cost effective, practical and safe in house reclamation system.

This paper is entitled a multi disciplined approach to handling waste and excess ink. We discovered early on how true this was. Our initial study was to determine the scope of waste generation and its cost to the printer. The numbers really surprise us and even more so those of our clients who participated in the study. The following charts indicate not only the volume of waste but also the
cost to the printer.

Company A Classification: Web Heatset Commercial
Year 1990 State - New York

Total lbs. of ink purchased	1,095,238 lbs.
A. Total price paid	$2,225,000
Pounds disposed of	58,600 lbs.
% of total purchase	5.3%
B. Cost of disposal - Test, freight and incineration	$43,657
Total cost of ink for 1990 (A+B)	$2,268,657
Actual ink needed for saleable copy	1,036,638
Price of ink needed for saleable copy	2,104,375
Difference	164,282

or 7 1/2% of total 1990 cost

Company B Classification: Web Heatset Publication
(Short Run)
Year 1991 State - Pennsylvania

Total lbs. of ink purchased	557,200 lbs.
A. Total price paid	$905,000
Pounds disposed of	51,000 lbs.
% of total purchased	9.1%
B. Cost of disposal - Test, freight, incineration	41,300
Total cost of ink for 1991 (A+B)	$946,300
Actual ink needed for saleable copy	506,200 lbs.
Price of ink needed for saleable copy	825,106
Difference	121,194 or 12.8% of total 1991 ink cost

Company C Classification: No Heat Business Forms
Year 1991 State - Maryland

Total lbs. of ink purchased	100,265 lbs.
A. Total price paid	$264,700
Pounds disposed of	None - 8500 accumulated
$ of total purchased	8.4%
B. Projected cost of disposal	13,600 (1.60 lb. - small generator)
Projected cost of ink	

1991 (A+B)	278,300
Actual Ink needed for saleable copy	86,665 lbs.
Price of ink needed for salable copy	$228,795
Difference	$ 49,505 or 17.8% of total 1991 ink cost

The general summation one can make is that some 6% of necessary ink expenditures in the lithographic field at least is wasted or thrown away each year. Heatset ink alone is a $280 million market and thus waste constitutes $16.8 million and 10 million lbs. on average per annum. A million dollar ink user would waste $60,000 and 36,000 lbs. of ink. Sobering numbers, especially when margins in our industry are so small. Therefore the development of discipline #1 - that of eliminating or reducing waste and excess generation in the first place. This involves predominantly the development and implementation of standard procedures ranging from estimating ink needs more accurately to such simple matters as allowing the fountains to run down toward the completion of the job. A rigorous training and monitoring program is necessary, otherwise gains will be minimal at best. In our best scenario during the program, waste was reduced by 60%; albeit from an initially extreme offender. More realistically a 40% reduction appears to be achievable. Using our scenario of 10 million lbs. wasted per annum, that still leaves a not inconsiderable amount to deal with.

Our evaluation of techniques currently being employed to recycle the waste and excess shows approaches as simple, and scary, as trying to feed the waste back into fresh ink filled

fountains to sophisticated (and expensive) filtration systems. Each approach however has it own drawbacks, not least of which is inflexibility in handling the plethora of color and other variations employed in a modern printing plant.

A detailed survey of a cross section of commercial and publication printers indicated that the most serious drawbacks to the consumption of recycled ink was the perception, and reality in most cases, that the recycled product was inferior to fresh ink and could only be used on "cheap", second rate work. Given that fact no pressman would consciously use it and if forced to do so at the first hint of a problem would replace it with new ink. The result was a buildup that would move about as quickly as the original waste generated, but now having more dollars invested. Thus our primary design parameter became that of reconstituting the ink to performance levels of fresh, standard ink. Easier said than done.

At this point in our study we collected a variety of waste and excess ink samples that represented a cross section of pressroom environments and operating parameters. They were analyzed in detail to determine their constitution with regards to both contaminants and physical properties. We concluded that, despite our fears to the contrary the levels and types of contaminant were fairly narrow and could be easily classified.

a. Paper Fibre - the largest solid category ranging as high as .03%.

b. Paper coating - very small, usually less than .005%.

c. Hard ink or skin - highly inconsistent

d. Liquid contaminant such as fountain solution - almost always less than 3%.

e. Others - which includes almost anything imaginable.

Interestingly most "other" is introduced into the waste stream after it is removed from the press and includes rags, cigarette butts, food, candy wrappers and, in one case a complete bustle wheel assembly.

The generally low levels of contaminant indicated that a relatively simple but flexible filtration system would be capable of removing most contaminants, those that were left being of the type inherently contained in an ink system in equilibrium during the lithographic process. We further found that the ratio of waste materials collected within one pressroom remain remarkable consistent over time. For instance, the ratio for our test publication site in process inks was Black 53%, Cyan 11%, Magenta 15%, Yellow 21% with no month varying more than 2% from those numbers in a six month study. Our commercial web printer showed ratios of Black 20%, Cyan 24%, Magenta 28%, Yellow 28%. Their situation was a little more complicated in that they frequently used spot colors. Thus the ratio of process ink to other color ran at an 85:15 level and variation was higher because of such things as annual report season where the ratio approached 50:50.

The most difficult aspect to handle was the physical properties of the collected material and it was only when we established the concept of treating the waste as a raw material that we were able to establish a viable program. This represents a fundamental change in the thought process. Whereas before the approach was to "fix" the waste the new method is to evaluate the properties of the waste - "base" and formulate it

into an ink. From hereon you will not hear me use the term "waste ink" but only "base". The following is a description of the process and equipment we have developed. It has involved designing, engineering, chemistry, physics, guessing and a lot of faith.

The installation in the printers plant consists of three basic components, namely a collection vessel, a mixer and a custom designed filtration/separation unit. The most effective mixer size is a 10 hp unit capable of handling mixes up to 600 lbs. in weight. It provides further flexibility to the printer in that beyond reclaiming the base ink it can be used for blending special colors in house at short notice and generally at a lower cost.

The collection vessel is a mobile unit that will hold a total of 600 lb. of material and can either be located at a central point or moved from press to press to collect the returns. Ink being charged into the vessel is passed through a coarse screen that serves the purpose of separating the "other" contaminants listed earlier. This is important if the ink is collected in smaller containers and transferred to the main vessel as this is where the bologna sandwich is introduced.

The vessel is filled to a set level, usually 50% of the total volume. This is determined by a dip stick approach. Once filled to this point the base is mixed thoroughly and a 200 gm sample is taken. This is sealed, placed in a special envelope and shipped overnight to our laboratories. Upon receipt the base sample is evaluated as a raw material. A series of standard tests are performed including:

a. Contaminant content by type and amount.

b. Tack and stability

c. Viscosity

d. Water pick up

e. Print test and colorimetric data.

This sequence has been refined to the point that it takes less than one hour to complete.

The technician then formulates an additive package of colorants, vehicles and modifiers to convert the base to match a predetermined standard ink. Initially this was done by traditional trial and error methods but we have now almost completed a software package which performs as an expert system. It is accurate over 90% of the time but still has a few bugs remaining. Once these are removed we expect to be able to offer it as an add on feature within the printers plant. Depending on his sophistication we expect to be able to utilize it in two forms -- one with full ink testing and the other with minimal input beyond printing the base on a proof press. It is early days yet, but does appear to be feasible in the long term.

Once the additive package is formulated a batch of it is manufactured in our plant corresponding in weight to the base weight submitted to us. It should be noted that in many cases it is not always necessary to use a 50:50 blend of base and additive to achieve a satisfactory formula, in some cases 80:20 blends are possible, but for the sake of simplicity and consistency everyone has agreed to the 50:50 method. Liquid contaminants have simply not been a problem as their concentration is cut in half and we formulate compensations into the additive.

The additive batch is shipped to the printing

plant where it is added to the base, mixed thoroughly and passed through the filtration system is plumbed to allow various flow configurations. The three filter canisters can be configured as follows:

Three in series

1 into 2

2 into 1

Three in parallel

Based on lab data generated on contaminant type, size and amount the recommended configuration and filter type is provided along with the additive. Most commonly used is a one into two sequence with the one being a 150 micron filter and the two being 25 microns apiece. With this arrangement a full batch is usually possible without needing a replacement filter during the run. The cleanliness of the batch thus processed equals and in many cases exceeds that of fresh ink. As the filter uses an air driven diaphragm pump with a regulator the risk of filter blowout or bypass is virtually nonexistent. Plugged filters result in pump shutdown and we have no recorded instance of failure.

The filtered ink is delivered into the container of choice for use in the particular plant. Initially we pumped it into the containers used to deliver the additive from our plant so that they were reused, but lately the larger users are pumping directly into tote bins -- a mark I believe of the confidence developing in the system.

A word at this point about color. All of the systems currently in use or being ;installed are generating black ink. It was determined early in our study that it is possible to reclaim individual colors as themselves, but at a varying rate of success depending on the color in question. The least likely candidate (and practically impossible if the standard is fresh ink) is yellow which is very susceptible to color contamination. As is typical it runs on press in the sequence spot where it can collect the most discoloration. Thus after a while an imbalance occurs where a blended base might contain nothing but dirty yellow and some black. We discovered that the cost of adjusting this base is prohibitive, frequently being higher by a significant factor than fresh ink. Also it is necessary to invest in individual units for each color as changeover is practically impossible. The apparent potential for economic recovery is therefore not as high as might first be expected and the complexity of managing multiple systems invalidates such an approach. Remember one of our major design parameters was simplicity of operation and management. Apparently our users feel the same way.

The burning question Does it work? The answer is a most definite yes. We currently have seven sites using the system on everything from hotel directories printed on newsprint all the way to the most elaborate and expensive high fashion catalogs where print quality is at a premium. Of course, each site has its own approved ink formula so in fact seven reclaimed inks exist. One of the sites has bought no fresh black ink for over six months as he is using up almost ten years of accumulated waste. Indeed our biggest single problem has been to catch each site up so that the units can in future be used for maintenance and recycling last weeks waste only because that is all there is. Twice we have had

to delay installations as we were being buried in bases. To date we have processed over 250,000 lbs. of ink with the systems.

What of the future? I work for an ink company and our business is ink making, not ink recycling. The system came into being as an adjunct to our core business and frankly for reasons of self preservation. The partnership aspect of business today does not allow us to ignore the needs of our clients in handling their waste and the knowledge and technology we can focus on the problem can only help all involved. Our long term intent is to continue to simplify the system and find a way to handle the metallic and opaque inks that can only be recycled sparingly at present. Once we have achieved that, the only ink leaving the printing plant will be in the form of an image on paper and we will be another step closer to the invisible product.