

Developing Cleaner Ink Formulations: A Flowchart for Ink Formulators



This product was developed by the Flexography Partnership of the Design for the Environment (DfE) Program at the U.S. Environmental Protection Agency (EPA). The Partnership performed a detailed study comparing hazards and risks, safety concerns, and cost and performance aspects of the three main flexo ink systems: solvent-based, water-based, and ultraviolet (UV)-cured. The complete results of the study, *Flexographic Ink Options: A Cleaner Technologies Substitutes Assessment* (CTSA), can be downloaded from the DfE website (www.epa.gov/dfe).

To develop and successfully market environmentally improved ink formulations, formulators need to be able to think about and implement a process for assessing inks. The information in this brochure will help you do that.

Getting the Right Mix: Performance, Environment, and Cost

Performance, environment, and cost are all critical in order for a formulator to claim marketplace success with an ink product line. Of course, without acceptable performance and cost criteria, a new ink product line will not be accepted by customers. What may not be so obvious is that environmental and health considerations also are critical to the success of inks. Inks with fewer and less serious environmental and worker risk concerns can lead to lower costs for formulators (and by extension for your customers), in many categories, including the following:

- regulatory requirements,
- insurance needs,
- air emissions,
- wastewater releases,
- solid waste disposal, and
- liability, mediation, and litigation.

Focus on environment, health, and safety

Ink formulators are continually searching for new performance and cost features to help penetrate and build market niches, hold onto customers, and allow inks to

work with different processes and materials. In just the same way, formulators can apply the process of continuous improvement to the **environment, health, and safety aspects of inks**, looking for such favorable aspects as:

- formulations with fewer and less-toxic chemicals,
- “cleaner” formulations (reduced environmental impacts),
- less need for press-side additives to maintain performance,
- inks that require less energy to run acceptably or dry quickly, and
- inks with fewer clean-up and disposal concerns.

Make improved ink safety a top goal of research and development.

The flexo industry constantly demands new and improved inks that can meet increasing performance needs. In addition to performance research, ink formulators can meet the needs of your customers by developing formulations that pose fewer and less potentially serious risks to workers and the environment.

Conduct and support environmental and health risk research.

Additional research will help ensure that the printing industry has access to as much information as possible about ink chemicals. Information is needed to identify chemicals that

- are not regulated and pose risks,



- have not undergone toxicological testing and have clear or potential risk concerns, and
- are new to the market, and thus much less likely to be regulated or thoroughly tested.

The “Sources of Chemical Information” in this brochure may help you identify avenues for research and analysis of your inks.

Not only will thoughtful research lead to improved environmental and safety features of ink formulations, but it will also help you market your products effectively and remain more competitive.

Develop partnerships for success

Remember that good teamwork will help your research efforts to be successful. Partnerships can help you obtain expert information and analysis, spread out the work load, and strengthen the commitment of everyone. Team players and partners can be found not only within your company, but among your suppliers, customers, trade associations, even the community in which your business is located.

Communicate with your customers

Printers see environmental and health risk issues as second only to performance when selecting an ink.¹ Ink company sales representatives are in an excellent position to inform printers of environmental, health, or safety improvements in your inks and to encourage adoption of “cleaner” inks. Explain to your customers that information is the key to getting the right mix of performance, environment, and cost aspects — and ultimately to more successful printing. Clear communication on your part will help ensure that your customers understand and support your goals. In turn, their support will provide a strong basis for your future research.

By encouraging your customers to accept alternative formulations, you can position these inks in the marketplace in ways that may help both you and your customers. For instance:

- Cleaner inks protect workers and lead to a safer workplace.
- Cleaner inks may help reduce operating costs.
- Cleaner inks contribute to a cleaner environment and a

safer community.

- Public image as environmentally responsible is good for business.

Also be sure to talk with your customers about other ways they can reduce environmental/health impacts of inks in operation. For example, they may be able to

- modify press equipment and/or operating procedures (e.g., install doctor blades),
- require press operators to wear appropriate personal protective equipment (e.g., butyl or nitrile gloves for all workers who handle inks),
- improve pressroom ventilation rates, and
- install new or better control equipment (e.g., oxidizers with water-based systems to destroy VOCs).

Talk with your suppliers

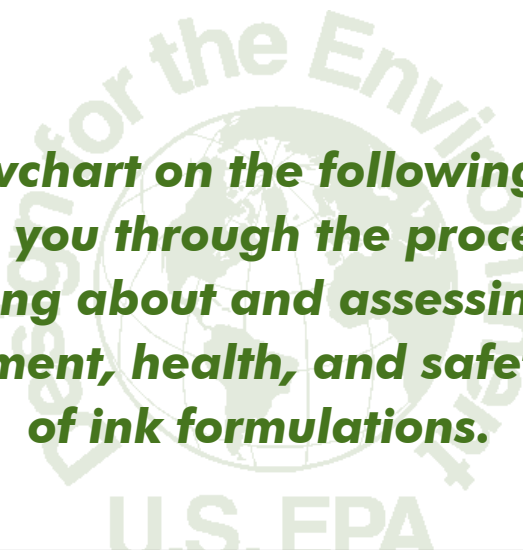
Developing cleaner formulations doesn’t have to stop with your **final** products. Your suppliers of ink inputs also play a very important role. Involving them in your process will not only encourage them to think about and work toward cleaner, safer materials. It also will expand responsibility, share the work, and in the long run ensure that workers and the environment are well protected. Some of the ways you can work with your suppliers include the following:

- Require them to provide all the information possible about the ingredients they sell you.
- Encourage them to conduct and support additional research about chemicals that have toxicities and potential risks.
- Challenge them to identify and make available chemicals that have reduced toxicity and lower potential environmental impacts, and to stop supplying more toxic and risk-prone chemicals.

Getting the right mix means continuous improvement

The goal of developing cleaner inks requires a continuous improvement process. Environmental improvements will not be achieved overnight, but must be viewed as a long-term, evolving process. Such a process need not be viewed as a burden, but rather it can be seen as an opportunity to strengthen your company in important ways.

¹ICF Consulting. 2000. Internal document for the EPA Design for the Environment Project. January 18, 2000.



**The flowchart on the following pages
takes you through the process of
thinking about and assessing the
environment, health, and safety issues
of ink formulations.**

Sources of Chemical Information

Following are some sources of chemical information to help you better build chemical profiles on flexographic ink ingredients and better understand the health and environmental impacts of flexo inks.

ASTDR (Agency for Toxic Substances and Disease Registry).
<http://atsdr1.atsdr.cdc.gov>

- **ToxFAQs.** A series of summaries about hazardous substances from the ATSDR Toxicological Profiles and Public Health Statements. Each fact sheet serves as a quick and easy-to-understand guide to the effects of hazardous substances on human health.
<http://www.atsdr.cdc.gov/toxfaq.html>
- **Toxicological Profiles.** Toxicological profiles for hazardous substances found at National Priorities List sites. Profiles include minimum risk levels.
<http://www.atsdr.cdc.gov/toxpro2.html>

ChemID. The National Library of Medicine's Chemical Dictionary. Contains over 339,000 compounds of biomedical and regulatory interest. Records include CAS Registry Numbers, molecular formulae, generic names, synonyms, and other references.

<http://chem.sis.nlm.nih.gov/chemidplus>

ChemFinder. Searchable database of chemical names, synonyms, CAS Registry Numbers, and molecular formulas.
<http://chemfinder.camsoft.com>

Chemical Right-to-Know (RTK) Initiative, U.S. EPA. Developed to rapidly test chemicals and make the data available to scientists, policy makers, industry, and the public.
<http://www.epa.gov/chemrtk>

ECOSAR (Ecotoxicity of Structure-Activity Relationships Database). Based on structure analysis, contains estimates of toxicity to fish, invertebrates, and aquatic plants.
<http://www.epa.gov/oppt/newchems/21ecosar.htm>

ECOTOX Database System. Chemical-specific ecological toxicity databases. Includes AQUIRE, for aquatic toxicity.
<http://www.epa.gov/ecotox>

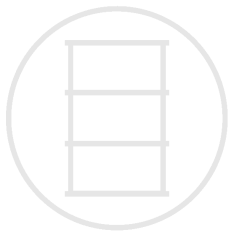
International Agency for Research on Cancer (IARC). Overall evaluations of carcinogenicity to humans. List and searchable database of chemicals evaluated as IARC Monographs.
<http://193.51.164.11>

National Toxicology Program (NTP) Annual Report on Carcinogens. This contains lists of chemicals known or reasonably anticipated to be carcinogenic to humans.
<http://ntp-server.niehs.nih.gov/NewHomeRoc/CurrentLists.html>

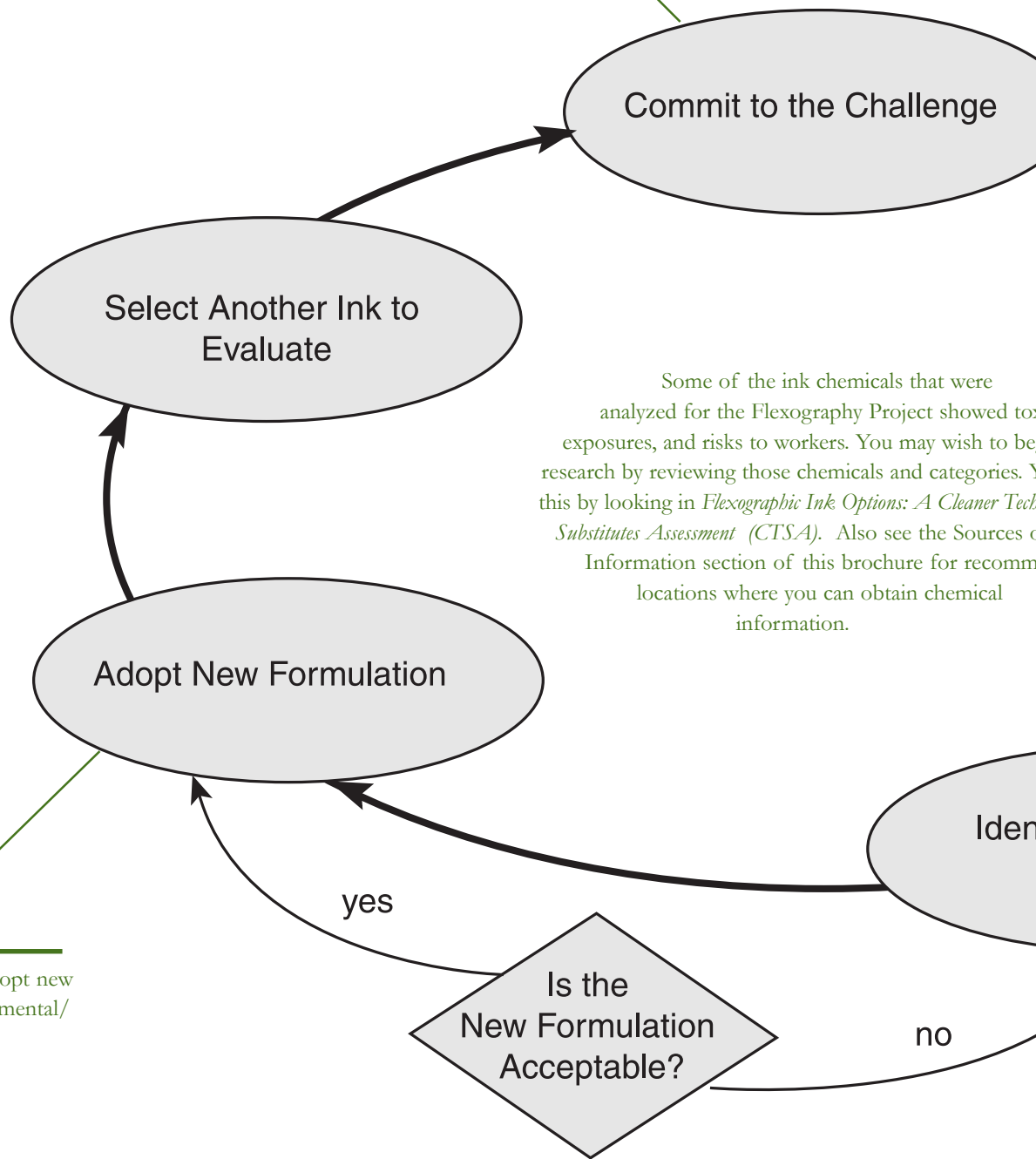
Office of Pollution Prevention and Toxics (OPPT), U.S. Environmental Protection Agency. Databases and software produced by OPPT are valuable tools for obtaining chemical and regulatory information.
<http://www.epa.gov/opptintr/opptdb.htm>



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Obtain management support to develop a “cleaner” ink.



Some of the ink chemicals that were analyzed for the Flexography Project showed toxic exposures, and risks to workers. You may wish to be research by reviewing those chemicals and categories. You this by looking in *Flexographic Ink Options: A Cleaner Technology Substitutes Assessment (CTSA)*. Also see the Sources of Information section of this brochure for recommended locations where you can obtain chemical information.

Encourage customers to adopt new formulation. Stress environmental/marketing reasons.

toxicity,
begin your
You can do
technologies
of Chemical
ended

Identify and Evaluate
Alternative

Identify Product to Evaluate

Conduct Baseline
Assessment of Each
Ingredient

Identify an ink to evaluate, because of concerns that may include:

- Safety issues
- Toxic or hazardous chemicals
- Known/potential risks to human health/environment
- Legal/regulatory requirements
- Performance problems
- High cost

Gather input and assistance, by teaming with printers, chemists, engineers, quality control, safety & health, legal, marketing, others.

Assess **toxicity**.

- Develop chemical profile. Consider acute and chronic toxicity as well as carcinogenicity.
- Consult MSDS, suppliers, and on-line information sources.

Assess anticipated **exposures** to workers and communities. Consider using mass-balance calculations, models, and monitoring data.

Assess potential risks, by considering both toxicity and expected exposures.

- You may want to do this qualitatively or quantitatively, depending on resources and priorities. For a quantitative assessment, does expected exposure exceed critical toxicity values (e.g., OSHA PELs, reference concentrations)?
- You may want to focus only on hazard, presuming that by minimizing toxicity, risk also will be minimized.

Decide if the ingredient presents **hazards or risks** to human health/environment.

- If so, could it be replaced with a more desirable (less toxic) chemical?
- If not, can you mitigate its potential environmental/health impacts?

Determine whether the alternative ingredient and formulation exhibit **acceptable properties**, such as:

- Performance
- Toxicity
- Worker safety
- Emissions
- Other environmental impacts
- Regulatory requirements





For printed copies of this or any DfE document, contact the National Service Center for Environmental Publications.

<http://www.epa.gov/ncepihom>
telephone: 1-800-490-9198

Sources of Chemical Information (continued)

- **EPA's Exposure Assessment webpage** includes exposure assessment methods, databases, and prediction models.
<http://www.epa.gov/opptintr/exposure>
- **Estimation Program Interface (EPI) Suite** is a series of physical/chemical property and environmental fate estimation models.
<http://www.epa.gov/opptintr/exposure/docs/episuite.htm>
<http://www.epa.gov/opptintr/exposure/docs/epiwin.htm>
- **Flexography Project website** contains many documents to help flexo professionals develop market environmentally improved ink formulations.
<http://www.epa.gov/dfe>

RTECs (Registry of Toxic Effects of Chemical Substances). Toxicity data for over 140,000 chemicals. Only available through commercial vendors; URL provides further vendors.

<http://www.cdc.gov/niosh/rtecs.html>

TOXNET. The National Library of Medicine's Toxicology Data Network. Contains databases on toxicology, hazardous chemicals, and related areas.

<http://toxnet.nlm.nih.gov>

Toxnet includes:

- **CCRIS (Chemical Carcinogenesis Research Information System).** Sponsored by the National Cancer Institute, a scientifically evaluated and fully referenced data bank containing some 8,000 chemical records with carcinogenicity, mutagenicity, tumor promotion, and tumor inhibition test results.
- **GENE-TOX.** Genetic toxicology (mutagenicity) test data, resulting from expert peer review of the open scientific literature for approximately 3,000 chemical substances.
- **HSDB (Hazardous Substances Data Bank).** Data file that focuses on the toxicology of over 4,500 potentially hazardous substances. Includes human exposure, industrial hygiene, emergency handling, and environmental fate. Scientifically peer-reviewed.
- **IRIS (Integrated Risk Information System).** An EPA database that contains health risk information on over 500 chemicals. This includes cancer weight-of-evidence classifications and cancer potency factors. These data have been reviewed by EPA and represent EPA consensus.
<http://www.epa.gov/iris>

The Design for the Environment (DfE) Flexography Project

The DfE Program is located within the Economics, Exposure and Technology Division of EPA's Office of Pollution Prevention and Toxics. DfE works directly with industries to help them integrate health and environmental considerations into their business decisions.

The DfE Flexo Project is a voluntary collaboration between representatives of the flexo industry and the U.S. Environmental Protection Agency. The Flexo Project performed a comprehensive, comparative assessment of risks, costs, and performance of a cross-section of inks.

The Flexo Project has developed a variety of materials to help flexo professionals. These materials are available on the DfE website (www.epa.gov/dfe). For more information, call the DfE Program at 202-564-8780 or send e-mail to dfe@epa.gov.