Introduction

We will define the steps necessary for a dyeing facility to meet waste water treatment regulations. Throughout the dyeing industry a move is underway by the various regulatory agencies to limit the amount of color that can be discharged into either a receiving stream or a municipal wastewater-treatment facility. Until recently, the municipal pretreatment ordinances only addressed the general parameters necessary for complying with secondary treatment standards. As a result, the pretreatment limits given to the dyeing plants usually did not address the color problem. Management in these plants invested a good deal of money in meeting only those pretreatment limits that were mandated by the municipality or the regulatory agency five to ten years ago.

With the recent advent of the color standard, the industry has found itself forced to look at a problem that was once considered minor.

However, with increased production rates, the problem becomes extremely costly and time consuming to control. For example, some dye houses literally dispose of their color effluent into tank trucks and transport the wastewater to a central disposal facility for treatment. Some dye houses discharge the colored water directly into a municipal system and are currently in a litigating situation over this discharge.

Unfortunately, in the dye industry the materials used to place color on the cloth are extremely resistant to precipitation in the discharged rinse water. In fact, classical engineering approaches for color removal are so costly that the industry can literally go bankrupt to meet operating costs.

Careful engineering steps, as outlined in this paper, can result in a dye house meeting color effluent limits in a cost effective manner. Such steps should include:

1) Regulatory Agencies—Although most industrial facilities look at the prospect of meeting with regulatory agencies with great reluctance, it is difficult to proceed with an engineering study without defining exactly what is required under existing and, more importantly, proposed regulations. It is suggested that a meeting be set up with the local basin or water management authority personnel to define exactly what they are looking for in terms of treatment limits. In many instances, dyeing facilities have agreed to limits, which on the initial survey, appear to be quite appropriate for their individual problem. However, inattention was paid to future limitations and extremely expensive equipment was installed in order to meet present limits.

A particular example of this is the construction of facilities to meet BOD and suspended solids, while little or no attention was paid to color. During the initial meeting with the regulatory agencies, a decision could have been made to pay a nominal surcharge to have the organics treated at the local wastewater treatment facility and to put the time and capital costs into removing color. When meeting with regulatory authorities, the company representative should be very careful never to agree to anything in writing until the technology levels have been established by a careful engineering study. Acquiescing to certain limits can cause severe problems later on if some type of litigation were to be instituted for failing to meet limits that, at the time, were assumed to be easily reached during the initial meetings with the regulatory authority.

2) Plant survey—A plant survey should be conducted and the total processes in the dyeing facility laid out in the form of an engineering drawing. This should require no more than one man day and enables a complete layout to be examined for possible means of reducing water flow and reducing some of the constituents that may be causing the initial color problem. A plant survey, and the accompanying engineering drawing, is always useful later in any negotiating process that may ensue with the regulatory authorities.

3) Water and material balance—Existing waste streams. An accurate water and material balance on the dyeing process and peripheral activities need to be done before proceeding further. This water and material balance, is necessary in order to proceed with accurate sizing of units and for an accurate treatability study.

4) Treatability study—Using the information gathered in the material balance, a representative composite sample should be taken on a routine basis and utilized to conduct treatability work to determine the best process for removing the color. The composite sample is extremely important, in that, any unit that is sized for handling a twenty-four
hour flow from the facility will need to take into account all varia-
tions in production and waste-
water flow. Dye houses are notorious for having fluctuating dis-
charges since the process is often in a batch form and discharged in-
termittently as a function of pro-
duction needs. The composite sample is the very basis for this treatability work.

Several different processes are available for removing color from waste water. The removing of color should be investigated in terms of the generation of any solid waste by-product. Some of the dyes used contain lead and other metals, which, when precipitated out in a coagulated form, will be listed as a hazardous solid waste. This should be looked at very closely in the treatability study and a precipitant avoided at all costs.

Previous studies have shown that ozone gives extremely dra-
matic results in color removal. In addition, the capital costs and operating costs are extremely small compared with other existing forms of wastewater treat-
ment. However, proper attention during the treatability study phase is necessary in order to assure that the units are sized properly for color removal. Ozone will not work unless very careful treatability work is done and accurate sizing based on the treatability study is accomplished.

During this and other phases, it is recommended that dye plant personnel be brought in as active participants in the "hands-on" aspect of the work so that the personnel can be familiar with the actual pollution-abatement procedures and can have a basis for operating any type of control equipment later on.

Proper treatability studies are the basis for keeping the capital costs and operating costs low for color-removal equipment. Using the "off-the-shelf" vendor approach in purchasing equipment for color removal can often lead to a "black box" solution which usually will not accomplish the pollution abatement objectives.

5) Conceptual design-The concept of an engineering drawing detailing the process flow and necessary unit steps to accomplish the color-removal objective, This enables plant personnel to refer to the drawing as the construction scenario unfolds. The conceptual drawing and narrative in the form of an engineering report enables plant personnel to take the initiative in actually ordering and installing necessary equipment. However, the process, if it becomes complex enough, should be tied in with an accurate detailed design.

6) Detailed design - in order to construct the necessary facility, a detailed design is necessary for both the contractor and the oper-
ating facility. The design should contain all the supporting equip-
ment needed to operate the units which may be purchased from a vendor at this time. Oftentimes, it may be necessary to fabricate the units if the uniqueness of the process requires it. For example, a contact chamber for ozone may be more cost-effectively fabricat-
ed rather than purchased off the shelf.

7) Construction-The actual construction and eventual opera-
tion of the facility can usually be a relatively inexpensive operation if the proper steps leading up to it are accomplished in a sound engineering manner. Oftentimes, an operator of a dyeing facility will be amazed at how simple the equipment looks once it is on site and operating, particularly for color removal. However, it is not the complexity of the equipment that is at issue, but the cost. Proper engineering in the very beginning phases for color re-

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moval, can save untold amounts of operating and capital costs further down the line. Simply changing the size of contact chambers or holding tanks accompanied with the potential of little or no sludge generation can yield a highly viable, and non-labor intensive, facility for color removal.

Conclusion
Many facilities in the dyeing industry agreed to regulations five and ten years ago which, at the time, seemed to make good sense for meeting the then-existing pollution-control regulations. However, the advent of stricter regulations and a predominate desire of regulatory agencies to remove color, even though there may be no toxic effects from a color discharge, have resulted in severe problems for many dye houses. Nonetheless, careful attention to the engineering concepts defined here can yield relatively low cost systems for color removal.