Dyes Derived from Benzidine and Its Congeners

I. Overview

This Action Plan addresses the use of benzidine-based dyes and benzidine congener-based dyes, both metalized and non-metalized, in products that would result in consumer exposure, such as for use to color textiles. There is a well-established concern for the potential carcinogenic effects presented by exposure to benzidine-based and benzidine congener-based dyes, and this Action Plan focuses on human carcinogenicity issues. EPA intends to address risk concerns from potential exposures by initiating rulemaking to add four benzidine-based dyes to an existing TSCA section 5(a)(2) significant new use rule (SNUR) for benzidine-based substances at 40 CFR 721.1660; and by initiating rulemaking to establish a new TSCA section 5(a)(2) SNUR for benzidine congener-based dyes, including 44 specific such dyes.

Because there may be concern for exposure to these dyes on imported finished textiles, EPA may also consider proposing to eliminate the article exemption applied to SNURs. If EPA learns that such activities are ongoing, EPA intends to consider initiating action under TSCA section 6. Furthermore, should EPA determine that there are other ongoing uses for these dyes, EPA intends to consider additional regulatory action to obtain information necessary to determine whether the uses present concerns which need to be addressed.

As part of the Agency's efforts to address benzidine-based and benzidine congener-based dyes, EPA also intends to evaluate the potential for disproportionate impact on children and other sub-populations.

II. Introduction

As part of EPA's efforts to enhance the existing chemicals program under the Toxic Substances Control Act (TSCA)[1], the Agency identified an initial list of widely recognized chemicals, including benzidine-based and benzidine congener-based dyes, for action plan development based on their presence in human blood; persistent, bioaccumulative, and toxic (PBT)[2] characteristics; use in consumer products; production volume; and other similar factors. This Action Plan is based on EPA's initial review of readily available use, exposure, and hazard information[3] on the dyes. EPA considered which of the various authorities provided under TSCA and other statutes might be appropriate to address potential concerns with the dyes in developing the Action Plan. The Action Plan is intended to describe the courses of action the Agency plans to pursue in the near term to address its concerns. The Action Plan does not constitute a final Agency determination or other final Agency action. Regulatory proceedings indicated by the

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[1] 15 U.S.C. §2601 *et seq.*

[2] Information on PBT chemicals can be found on the EPA website at http://www.epa.gov/pbt/.

[3] Information sources customarily employed include Inventory Update Reporting (IUR) submissions; Toxic Release Inventory (TRI) reporting; data submitted to the HPV Challenge Program; existing hazard and risk assessments performed by domestic and international authorities including but not limited to U.S. Federal government agencies, the Organization for Economic Cooperation and Development, the Stockholm Convention on Persistent Organic Pollutants, Health and Environment Canada, the European Union; and others. Action plans will reference specific sources used.

Action Plan will include appropriate opportunities for public and stakeholder input, including through notice and comment rulemaking processes.

III. Scope of Review

Benzidine and its congeners constitute a family of similar synthetic aromatic amines which are important precursors in the synthesis of dyes. Some of these dyes have the potential to metabolize to aromatic amines that are considered to be carcinogenic (NTP, 2005). Benzidine and dyes metabolized to benzidine are considered "known human carcinogens". Benzidine's congeners, 3,3'-dichlorobenzidine, 3,3'-dimethylbenzidine, and 3,3'-dimethoxybenzidine and dyes metabolized to the latter two congeners have all been classified as "reasonably anticipated to be human carcinogens" (NTP, 2005).

The 2006 Inventory Update Report (IUR) indicated that a number of benzidine-based or congener-based dyes and pigments were produced in high volumes. This observation resulted in a decision to review the current status of the category of dyes and pigments derived from benzidine and its congeners in products that could result in potential consumer exposure. In reviewing the benzidine congener-based pigments, EPA believes that the presence of pigments in such consumer products as printing inks, paints, plastics, and textiles was unlikely to present an exposure concern, because the pigments are not bioavailable and are not absorbed into the body (Environment Canada, 2009, Golka, et al, 2004, OECD, 2003,). Additionally EPA believes that some of the congener-based dyes reported to the 2006 IUR were not likely to degrade to carcinogenic amines (Jung, R., et al, 1992).

EPA therefore decided to focus on dyes derived from benzidine and its congeners that are listed on the non-confidential business information (CBI) TSCA Inventory and have the potential to degrade to carcinogenic amines. A search of the non-CBI TSCA Inventory found 48 substances not already subject to TSCA SNUR authority. These are divided among two lists (see Appendix 1.):

- List 1. Benzidine Based Dyes -- 4 substances
- List 2. Benzidine Congener-Based Dyes -- 44 substances

As these dyes all have the potential to degrade to benzidine or a benzidine congener, EPA chose to consider whether there are concerns about consumer exposure to the dyes in products that need to be addressed.

IV. Uses and Substitutes Summary

Benzidine-based and congener-based dyes (also called azo dyes) are used in the production of textiles, paints, printing inks, paper, and pharmaceuticals. They are also used as reagents and biological stains in laboratories, are used in the food industries, and have more recent uses in laser, liquid crystal displays, ink-jet printers, and electro-optical devices (Dapson, 2009, Kamboh, et al, 2009, Oomen, et al, 2004).

Dye production in the U.S. has been steadily declining for the past decade, largely due to the increase in imported finished textiles. Most of the imported volume comes from China and India and other less developed countries which may have less stringent regulations on dye intermediates (Dapson, 2009). No List 1 dyes were reported and only two List 2 dyes were reported on the 2006 IUR and since their volume was below 500,000 pounds per year, no exposure and use data was reported. Only 12 of the List 2 and none of the List 1 dyes were believed to be available in the U.S., and two others are available internationally but could end up in U.S. products. Given that dyes are quite often available from importers, reformulators and others who distribute in small volumes, it is assumed that there are a number that were not readily identified, because they are produced in volumes below the 2006 IUR reporting threshold (25,000 pounds per year). Because the European Union has had a ban on the use of certain azo dyes, such as those on Lists 1 and 2, in textiles and leather that are in prolonged contact with human skin, there are readily available substitutes for the use of benzidine and congener dyes in textiles and leather.

V. Hazard Identification Summary

The 1980 EPA Preliminary Risk Assessment on derivatives of benzidine and its congeners established that the primary hazard concern was for the carcinogenic effects to humans from exposure to specific metabolites of the dyes (EPA, 1980). Therefore, the hazard review for this Action Plan focuses on human carcinogenicity issues. Azo dyes are biologically active through their metabolites. Azoreduction of these compounds occurs in humans by an enzyme-mediated reaction. Azoreductases are found in the liver, in gut bacteria, and in skin bacteria. The result of this azoreduction is the release of the carcinogenic aromatic amine from the dye. Studies have demonstrated that the azoreduction of benzidine-based dyes occurs in the human body as well as on the skin (Golka, et al, 2004). Therefore, the primary human health concern for consumers is exposure to the benzidine-based and benzidine-congener-based dyes through oral, dermal or inhalation routes. Evidence from animal studies suggests that there is early life susceptibility to benzidine carcinogenesis. Cancer potency for benzidine was substantially increased when the dose was given in early life as compared to adults (EPA, 2005).

It appears that metal chelation does not completely eliminate the carcinogenic effects of metalized dyes derived from bendizine congeners; therefore, the metalized congener dyes have been included in List 2 (Morgan, et al, 1994). The four dyes on List 1 have the potential to degrade to benzidine. List 2 includes 17 dimethylbenzidine-based dyes, 26 dimethoxybenzidine-based dyes and 1 dichlorobenzidine-based dye, all of which would be expected to degrade to their carcinogenic precursors and would therefore present a potential exposure concern in consumer products

VI. Fate Characterization Summary

Azo dyes have been expected to resist biodegradation, because they are synthetic. However, the problems of discharge of dye contents to wastewaters from textile and other industries have resulted in extensive research for biological methods to degrade dyes and other organic pollutants. Under certain environmental conditions, various fungi, bacteria, yeasts and algae have been found to be capable of decolorizing and sometimes completely mineralizing

many azo dyes. Different trophic groups of microorganisms are capable of degrading azo dyes under anaerobic, anoxic and aerobic conditions (Pandey, et al, 2007).

VII. Exposure Characterization Summary

The main routes of consumer exposure to azo dyes are (Zeilmaker, et al, 1999, Zeilmaker, et al, 2000):

- Dermal absorption is the primary route from wearing azo-dyed clothing or footwear and using azo-dyed materials such as paper and inks.
- Oral ingestion is an additional route for babies and young children who suck on clothing, blankets, and other non-food products which might contain azo dyes.
- Inhalation exposure is a more important route in occupational settings; however, it can also occur from the use of azo-dyed inks during "air brushing" or from off-gassing from azo-dyed carpets to indoor air.
- Contact with azo dyes entering the environment through the whole life cycle of azo dyes in textiles is an additional potential source of exposure.

Actual dermal exposure does occur from the leaching of azo dyes by sweat in contact with the dyed textiles. Studies have shown that various types of human skin bacteria possess the azo reductases necessary to breakdown azo dyes to release the carcinogenic amines, which can be absorbed. Additionally, once on the skin, the dye itself may be absorbed. It is well established that azoreduction also occurs internally in the gut and the liver (Zeilmaker, et al, 1999, Zeilmaker, et al, 2000).

Three European studies experimentally examined the leaching of amines and azo dyes from consumer textile products, including leather. Two of the studies used a variety of assumptions to estimate life-long daily uptake values for dermal exposure to various pieces of azo-dyed clothing and footwear shown to contain benzidine or a congener. When comparing their values to EPA's acceptable 10^{-6} level for benzidine (and extrapolated to the other congeners), they determined that exposure to the azo-dyed clothing and footwear would result in a cancer risk above the "negligible risk level" (NRL). (Zeilmaker, et al, 1999, Zeilmaker, et al, 2000). In addition to the fact that the studies reported data from dyed products purchased in Europe, many assumptions were used, often worst cases assumptions which may overestimate exposure. Also, it was noted that the main factors determining dye releases from textiles to the skin include the type of dyed textile, contact with other substrates, amount of dye applied to the textile, and number of previous washings.

Nevertheless, during a similar time period as the studies discussed above, a risk committee for the European Commission reviewed a report on consumer exposure to diazo textile dyes (unavailable) and agreed with the report's conclusion that while consumer exposure is likely to be very low, the associated cancer risks give enough cause for concern that the use of azo dyes which can degrade to 22 carcinogenic aromatic amines be restricted to the lowest possible levels or banned (European Commission, 1999).

VIII. Risk Management Considerations

Current Regulatory Status in North America and Europe

Occupational exposure to some dyes derived from benzidine and its congeners has been regulated for many years; however, the potential for consumer exposure to products containing these products is still a potential concern. The EU has banned in textile and leather articles which may come into direct and prolonged contact with humans the use of azo dyes which can break down to release any of 22 listed carcinogenic aromatic amines (includes benzidine and its congeners) in amounts above 30 ppm in finished articles or the dyed parts (See Restriction 43 in REACH Annex XVII, European Commission, 2009). Canada has also expressed concern about the potential release of benzidine or its congeners from azo dyes and is evaluating potential approaches for addressing azo dyes (Environment Canada, 2009).

In 1995, when EPA proposed a significant new use rule (SNUR) on benzidine-based substances, EPA indicated that this was the first step in a risk management strategy to reduce the risks associated with the manufacture and use of benzidine-based and benzidine congener-based dyes and pigments (60 FR 45119, 8/30/95). The SNUR at 40 CFR §721.1660 is for any use of 22 benzidine-based substances. These substances were not included in this Action Plan. Exempt from the SNUR were minor ongoing specified uses as analytical reagents and biological stains.

When EPA finalized that first SNUR, EPA recognized that additional benzidine-based substances would need to be added. The four benzidine-based dyes on List 1 had been included in draft additions to §721.1660 which were never finalized (61 FR 52287, 10/7/96). With the exception of the seven metalized congener dyes and the one DCB-based dye, the other 37 dyes on List 2 had been included in a draft of a proposed SNUR for non-metalized dyes based on dimethylbenzidine and dimethoxybenzidine that was never finalized.

Benzidine-based and congener-based dyes -- Potential concerns for humans

Risk from consumer use of products containing dyes. Because of the azoreductases present in the human body and in bacteria on the skin, consumer products using the dyes could present a concern. The main products presenting a concern would be textiles and leather products that are in prolonged contact with human skin. The other products are either not available to consumers (laboratory chemicals) or would not likely be readily accessible in significant quantities (printing ink or LCD displays) to present an exposure concern.

Risk to the general population from dyes released to the environment. Biodegradation studies indicate that the dyes would be expected to biodegrade at negligible to slow rates under aerobic conditions in the environment. However, in anaerobic soils the dyes are likely to undergo azo reduction to benzidine and/or congeners depending on structure. It is unclear whether metabolites from these reductions would be available in large concentrations or locations to be of concern to the general population.

Assumptions and Uncertainties

Based on market information and the fact that the 2006 IUR had no reports for the benzidine-based dyes, it appears that if the dyes are used at all, they would be used in small volumes, making it difficult to access production and use information. Additionally, it appears that new uses of azo dyes in high tech applications have been developed since EPA last examined the market. Although it is unclear whether the dyes on Lists 1 and 2 are used in these applications, it is assumed that these new uses would be less likely to result in significant consumer exposure to the dyes.

As many of the Direct Blue dyes on List 2 have been identified as having potential uses as biological stains and as having anti-viral activity, it is unknown how much of the production volume would be attributed to those uses, which would generally not be a concern for consumers or not subject to TSCA (e.g., pharmaceuticals). The only consumer exposure data available for analysis comes from a few European studies which may or may not be applicable in the U.S. Those studies also used many assumptions to prepare their estimates and identified important variables which affect the amount of dye released from textiles to the skin. However, given the evidence for early life susceptibility to benzidine, EPA believes that it is important to consider actions to address children's potential exposure to dyes which can metabolize to benzidine and benzidine-based congeners.

Given that dye production has been shifting to Asia and importation of finished textiles has increased, it is possible that the risk of exposure to azo dyes in the U.S. would be more from dyes on imported finished textiles than from dyes manufactured or imported and used to finish textiles in the U.S.

IX. Next Steps

List 1 Benzidine-Based Dyes

EPA intends to initiate rulemaking to add the four List 1 dyes to the existing TSCA section 5(a)(2) significant new use rule for benzidine-based substances at 40 CFR 721.1660.

- In order to use the SNUR authority, EPA must be aware that the uses it chooses to regulate are not ongoing or exempt ongoing uses.
- The existing SNUR at 40 CFR 721.1660 already covers listed benzidine-based substances. EPA could choose to add the four List 1 benzidine-based dyes to that SNUR.
- Request comment on whether there are for ongoing uses as analytical reagents and lab stains and indicate that the exemption at 721.1660 would likely continue to apply.
- There is some uncertainty about the extent of current uses; however, the market profile did not find information indicating that any of the four List 1 substances are available in the U.S. Therefore, it is clear that any uses would be very small quantities.
- If public comments on the proposed SNUR indicate that there are existing uses beyond minor laboratory uses, EPA may need to consider additional action such as TSCA section 6 rulemaking, depending on the potential exposure scenarios presented by any existing uses. In making such a consideration, EPA would evaluate whether those existing uses indicated

the potential to present an unreasonable risk, in coordination with CPSC and/or other agencies where appropriate.

List 2 Benzidine Congener-Based Dyes

EPA intends to prepare a new proposed TSCA section 5(a)(2) significant new use rule for benzidine congener-based dyes and include the List 2 dyes.

- In order to use the SNUR authority, EPA must be aware that the uses it chooses to regulate are not ongoing or exempt ongoing uses.
    - Some of the Direct Blues appear to have application as biological stains and pharmaceuticals. The stain uses could be exempted and the pharmaceutical uses are not subject to TSCA.
    - There is much uncertainty about the uses of and potential exposures to the dyes in both textiles and the newer high tech fields.
- EPA could draft a proposed benzidine congener-based SNUR for the List 2 dyes, indicating an intention to exempt minor laboratory uses that are reported during the comment period.
- If ongoing uses in high technology applications, such as LCD displays, are reported, EPA could further evaluate potential exposure concerns before addressing those uses.

EPA will search the CBI TSCA Inventory to identify benzidine-based and benzidine congener-based dyes that could be added to List 1 or List 2 and included in the above SNURs.

Because there is concern for exposure to azo dyes on imported finished textiles, EPA could propose eliminating the article exemption applied to the above SNURs.

If EPA determines that List 1 and/or 2 dyes are currently coming into the U.S. on imported finished textiles, EPA intends to consider initiating regulatory action under TSCA section 6. In making such a consideration, EPA would evaluate whether those existing uses indicated the potential to present an unreasonable risk, in coordination with CPSC and/or other Agencies where appropriate.

When EPA proposes the SNURS, EPA will request comment on using TSCA section 6 as an alternative approach to the SNUR process.

X. References

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Appendix 1.
Benzidine-Based and Congener-Based Dyes
With Potential to Degrade to Carcinogenic Amines

List 1: Benzidine-Based Dyes on the Non-CBI TSCA Inventory	
CAS NO	**CHEMICAL NAME[1]**
117-33-9	1,3-Naphthalenedisulfonic acid, 7-hydroxy-8-[[4'-[(4-hydroxyphenyl)azo][1,1'-biphenyl]-4-yl]azo]-
65150-87-0	1,3,6-Naphthalenetrisulfonic acid, 8-hydroxy-7-[[4'-[(2-hydroxy-1-naphthalenyl)azo][1,1'-biphenyl]-4-yl]azo]-, trilithium salt
68214-82-4	2,7-Naphthalenedisulfonic acid, 5-amino-3-[[4'-[(7-amino-1-hydroxy-3-sulfo-2-naphthalenyl) azo][1,1'-biphenyl]-4-yl]azo]-4-hydroxy-, disodium salt [**CI Direct Navy BH**]
72379-45-4	2,7-Naphthalenedisulfonic acid, 4-amino-5-hydroxy-3-[[4'-[[2-hydroxy-4-[(2-methylphenyl) amino]phenyl]azo] [1,1'-biphenyl]-4-yl]azo]-6-(phenylazo)-

List 2: Benzidine Congener-Based Dyes on the Non-CBI TSCA Inventory	
CAS NO	**CHEMICAL NAME[1]**
72-57-1	2,7-Naphthalenedisulfonic acid, 3,3'-[(3,3'-dimethyl[1,1'-biphenyl]-4,4'-diyl)bis(azo)]bis[5-amino-4-hydroxy-, tetrasodium salt [**CI Direct Blue 14**, tetrasodium salt; Trypan Blue]
117-32-8	1,3-Naphthalenedisulfonic acid, 7-hydroxy-8-[[4'-[(4-hydroxyphenyl)azo]-3,3'-dimethyl[1,1'-biphenyl]-4-yl]azo]-
314-13-6	1,3-Naphthalenedisulfonic acid, 6,6'-[(3,3'-dimethyl[1,1'-biphenyl]-4,4'-diyl)bis(azo)]bis[4-amino-5-hydroxy-, tetrasodium salt [**CI Direct Blue 53**, tetrasodium salt; Evans Blue]
992-59-6	1-Naphthalenesulfonic acid, 3,3'-[(3,3'-dimethyl [1,1'-biphenyl]-4,4'-diyl)bis(azo)] bis[4-amino-, disodium salt [**CI Direct Red 2, disodium salt**; Benzopurpurin 4B]
2150-54-1	2,7-Naphthalenedisulfonic acid, 3,3'-[(3,3'-dimethyl [1,1'-biphenyl] -4,4'-diyl)bis(azo)] bis[4,5-dihydroxy-, tetrasodium salt [**CI Direct Blue 25, tetrasodium salt**;p Benzo Sky Blue]
2429-71-2	1-Naphthalenesulfonic acid, 3,3'-[(3,3'-dimethoxy [1,1'-biphenyl]-4,4'-diyl)bis(azo)]bis [4-hydroxy-, disodium salt [**CI Direct Blue 8, disodium salt;** Benzoazurine G]
2429-74-5	2,7-Naphthalenedisulfonic acid, 3,3'-[(3,3'-dimethoxy[1,1'-biphenyl]-4,4'-diyl)bis(azo)]bis[5-amino-4-hydroxy-, tetrasodium salt [**CI Direct Blue 15**, tetrasodium salt; Direct Sky Blue]
2586-57-4	1,3-Naphthalenedisulfonic acid, 4-amino-5-hydroxy-6-[[4'-[(2-hydroxy-1-naphthalenyl) azo]-3,3'-dimethoxy [1,1'-biphenyl]-4-yl]azo]-, disodium salt [**CI Direct Blue 22, disodium salt**; Chicago (Niagra) Blue RW]
2610-05-1	1,3-Naphthalenedisulfonic acid, 6,6'-[(3,3'-dimethoxy[1,1'-biphenyl]-4,4'-

List 2: Benzidine Congener-Based Dyes on the Non-CBI TSCA Inventory	
CAS NO	**CHEMICAL NAME[1]**
	diyl)bis(azo)]bis[4-amino-5-hydroxy-, tetrasodium salt [**CI Direct Blue 1,** tetrasodium salt; Chicago/Sky Blue 6B]
3841-14-3	1,3-Naphthalenedisulfonic acid, 6,6'-[(3,3'-dimethoxy[1,1'-biphenyl]-4,4'-diyl)bis(azo)]bis[4-amino-5-hydroxy- [**CI Direct Blue 1, free acid**; Chicago Sky Blue 6B]
4198-19-0	2,7-Naphthalenedisulfonic acid, 3,3'-[(3,3'-dimethoxy [1,1'-biphenyl]-4,4'-diyl)bis(azo)] bis[4,5-dihydroxy-, tetrasodium salt [**CI Direct Blue 10**; Dianil Blue G]
6358-29-8	1,3-Naphthalenedisulfonic acid, 8-[[4'-[(4-ethoxyphenyl) azo]-3,3'-dimethyl[1,1'-biphenyl]-4-yl]azo]-7-hydroxy-, disodium salt [**CI Direct Red 39, disodium salt**]
6405-94-3	Benzenesulfonic acid, 3,3'-[(3,3'-dimethyl [1,1'-biphenyl]-4,4'-diyl)bis(azo)] bis[2,4-diamino-5-methyl-, disodium salt [**CI Direct Orange 10**]
6449-35-0	1-Naphthalenesulfonic acid, 3-[[4'-[(6-amino-1-hydroxy-3-sulfo-2-naphthalenyl) azo]-3,3'-dimethoxy[1,1'-biphenyl]-4-yl]azo]-4-hydroxy-, disodium salt [**CI Direct Blue 151, disodium salt**]
6459-94-5	1,3-Naphthalenedisulfonic acid, 8-[[3,3'-dimethyl-4'-[[4-[[(4-methylphenyl)sulfonyl] oxy]phenyl]azo] [1,1'-biphenyl]-4-yl]azo]-7-hydroxy-, disodium salt [**CI Acid Red 114, disodium salt**; Milling Red B]
6548-29-4	2,7-Naphthalenedisulfonic acid, 4,4'-[(3,3'-dichloro[1,1'-biphenyl]-4,4'-diyl)bis(azo)] bis[3-amino-, tetrasodium salt [**CI Direct Red 46, tetrasodium salt**]
6739-62-4	Benzoic acid, 2-[[2-amino-6-[[4'-[(3-carboxy-4-hydroxyphenyl)azo]-3,3'-dimethoxy[1,1'-biphenyl]-4-yl]azo]-5-hydroxy-7-sulfo-1-naphthalenyl]azo]-5-nitro-, trisodium salt [**CI Direct Black 91**]
12222-00-3	Cuprate(4-), [.mu.-[[4,4'-[[3,3'-di(hydroxy-.kappa.O) [1,1'-biphenyl]-4,4'-diyl]bis(azo-.kappa.N1)]bis[3-(hydroxy-.kappa.O)-2,7-naphthalenedisulfonato]](8-)]]di-, tetrasodium [**CI Direct Blue 80**]
17011-51-7	Ethanesulfonic acid, 2,2'-[(3,3'-dimethoxy-4,4'-biphenylylene)bis[azo(methylimino)]]di-, disodium salt
28407-37-6 (former = 10401-50-0)	Cuprate(4-), [.mu.-[[3,3'-[[3,3'-di(hydroxy-.kappa.O) [1,1'-biphenyl]-4,4'-diyl]bis(azo-.kappa.N1)]bis[5-amino-4-(hydroxy-.kappa.O)-2,7-naphthalenedisulfonato]](8-)]] di-, tetrasodium [**CI Direct Blue 218**]
64743-15-3	Benzoic acid, 5-[[4'-[[2,6-diamino-3-methyl-5-[(4-sulfophenyl)azo]phenyl]azo]-3,3'-dimethyl [1,1'-biphenyl]-4-yl]azo]-2-hydroxy-, disodium salt [**CI Direct Brown 222**]
65151-33-9	2,7-Naphthalenedisulfonic acid, 4,4'-[(3,3'-dimethoxy[1,1'-biphenyl]-4,4'-diyl)bis(azo)]bis[3-hydroxy-, tetrasodium salt
65152-14-9	1,6-Naphthalenedisulfonic acid, 4-amino-3-[[4'-[(1-amino-4-sulfo-2-naphthalenyl)azo]-3,3'-dimethyl[1,1'-biphenyl]-4-yl]azo]-, trisodium salt

List 2: Benzidine Congener-Based Dyes on the Non-CBI TSCA Inventory	
CAS NO	**CHEMICAL NAME[1]**
65152-15-0	1,7-Naphthalenedisulfonic acid, 4-amino-3-[[4'-[(1-amino-4-sulfo-2-naphthalenyl)azo]-3,3'-dimethyl[1,1'-biphenyl]-4-yl]azo]-, trisodium salt
66214-51-5	2,7-Naphthalenedisulfonic acid, 5-amino-3-[[4'-[(7-amino-1-hydroxy-3-sulfo-2-naphthalenyl) azo]-3,3'-dimethyl[1,1'-biphenyl]-4-yl]azo]-4-hydroxy-, trisodium salt
66225-65-8	Cuprate(2-), [5-[[4'-[[2,6-dihydroxy-3-[(2-hydroxy-5-sulfophenyl)azo]phenyl]azo]-3,3'-dimethyl[1,1'-biphenyl]-4-yl]azo]-2-hydroxybenzoato(4-)]-, disodium
66418-17-5	Cuprate(3-), [.mu.-[4-[[4'-[(6-amino-1-hydroxy-3-sulfo-2-naphthalenyl)azo]-3,3'-dihydroxy[1,1'-biphenyl]-4-yl]azo]-3-hydroxy-2,7-naphthalene disulfonato(7-)]]di-, trisodium
66418-18-6	Cuprate(4-), [.mu.-[3-[[3,3'-dihydroxy-4'-[(2-hydroxy-3,6-disulfo-1-naphthalenyl)azo][1,1'-biphenyl]-4-yl]azo]-4-hydroxy-2,7-naphthalene disulfonato(8-)]]di-, tetrasodium
67893-48-5	Benzoic acid, 5-[[4'-[(2,4-diamino-5-sulfophenyl) azo]-3,3'-dimethyl[1,1'-biphenyl]-4-yl]azo]-2-hydroxy-, disodium salt
68084-09-3	2,7-Naphthalenedisulfonic acid, 5-amino-4-hydroxy-3-[[4'-[(2-hydroxy-3,6-disulfo-1-naphthalenyl)azo]-3,3'-dimethoxy[1,1'-biphenyl]-4-yl]azo]-, tetrasodium salt
68084-21-9	1,3-Naphthalenedisulfonic acid, 4-amino-5-hydroxy-6-[[4'-[(2-hydroxy-3,6-disulfo-1-naphthalenyl)azo]-3,3'-dimethoxy[1,1'-biphenyl]-4-yl]azo]-, tetrasodium salt
68084-22-0	2,7-Naphthalenedisulfonic acid, 4-[[4'-[(6-amino-1-hydroxy-3-sulfo-2-naphthalenyl)azo]-3,3'-dimethoxy[1,1'-biphenyl]-4-yl]azo]-3-hydroxy-, trisodium salt
68084-23-1	1,3-Naphthalenedisulfonic acid, 4-amino-6-[[4'-[(1,8-dihydroxy-3,6-disulfo-2-naphthalenyl)azo]-3,3'-dimethoxy[1,1'-biphenyl]-4-yl]azo]-5-hydroxy-,tetrasodium salt
68140-31-8	Cuprate(3-), [.mu.-[3-[[3,3'-di(hydroxy-.kappa.O) -4'-[[2-(hydroxy-.kappa.O)-8-hydroxy-6-sulfo-1-naphthalenyl]azo-.kappa.N1][1,1'-biphenyl]-4-yl]azo-.kappa.N1]-4-(hydroxy-.kappa.O)-5-hydroxy-2,7-naphthalenedisulfonato(7-)]]di-, trisodium [**CI Direct Blue 214**]
68345-21-1	2,7-Naphthalenedisulfonic acid, 3-[[3,3'-dimethyl-4'-[[4-[[(4-methylphenyl)sulfonyl]oxy] phenyl] azo][1,1'-biphenyl]-4-yl]azo]-4-hydroxy-5-[[(4-methylphenyl) sulfonyl]oxy]-, disodium salt
68966-43-8	2,7-Naphthalenedisulfonic acid, 3,3'-[(3,3'-dimethoxy [1,1'-biphenyl]-4,4'-diyl)bis(azo)] bis[5-amino-4-hydroxy-, sodium salt, compd. with 2,2'-iminobis[ethanol]
68966-50-7	2,7-Naphthalenedisulfonic acid, 3,3'-[(3,3'-dimethoxy[1,1'-biphenyl]-4,4'-diyl)bis(azo)] bis[5-amino-4-hydroxy-, sodium salt
70210-32-1	Benzenesulfonic acid, 3-(benzoylamino)-4-hydroxy-5-[[1-[[[4'-[[2-[[2-hydroxy-5-(methyl sulfonyl)phenyl]azo]-1,3-dioxobutyl]amino]-3,3'-dimethoxy[1,1'-biphenyl]-4-yl]amino] carbonyl]-2-oxopropyl]azo]-, monosodium salt
70632-09-6	Benzoic acid, 5-[[4'-[[2,6-diamino-3-[(4-sulfophenyl) azo]phenyl]azo]-3,3'-dimethyl [1,1'-biphenyl]-4-yl]azo]-2-hydroxy-, dilithium salt
71550-22-6	2,7-Naphthalenedisulfonic acid, 3,3'-[(3,3'-dimethoxy[1,1'- biphenyl]-4,4'-diyl)bis(azo)] bis[5-amino-4-hydroxy -, tetralithium salt [**CI Direct Blue 15 or Trypan Blue, tetralithium salt**]
71566-41-1	Benzoic acid, 2-[[2-amino-5-hydroxy-6-[[4'-[(2-hydroxy-6-sulfo-1-naphthalenyl)azo]-3,3'-

List 2: Benzidine Congener-Based Dyes on the Non-CBI TSCA Inventory	
CAS NO	**CHEMICAL NAME[1]**
	dimethoxy[1,1'-biphenyl]-4-yl]azo]-7-sulfo-1-naphthalenyl]azo]-5-nitro-, trisodium salt
71701-30-9	2,7-Naphthalenedisulfonic acid, 3-[[3,3'-dimethyl -4'-[[4-[(phenylsulfonyl)oxy] phenyl]azo] [1,1'-biphenyl]-4-yl]azo]-4-hydroxy-, disodium salt
71873-63-7 (former = 12217-56-0)	Cuprate(4-), [.mu.-[7-[[3,3'-di(hydroxy-.kappa.O) -4'-[[4-(hydroxy-.kappa.O)-2-sulfobenzo [a]phenazin-3-yl]azo-.kappa.N1] [1,1'-biphenyl]-4-yl]azo-.kappa.N1]-8-(hydroxy-.kappa.O)-1,3,6-naphthalene trisulfonato(8-)]]di-, tetrasodium [**CI Direct Blue 90**]
101200-51-5	Benzoic acid, 2-[[2-amino-5-hydroxy-6-[[4'-[(2-hydroxy-6-sulfo-1-naphthalenyl)azo]-3,3'-dimethoxy[1,1'-biphenyl]-4-yl]azo]-7-sulfo-1-naphthalenyl]azo]-5-nitro-, disodium salt

[1]Common names are not unique identifiers as they may be applied to more than one CAS No.; however, they are frequently used, even in peer-reviewed literature.