Monitoring chromium in leather and leather tanning wastewater is essential for preserving environmental and human health.
Image Source: Pexels user Jay Mantri

The manufacture of everyday objects and materials relies on a variety of substances whose use may have **serious health consequences if not properly contained**. In the leather tanning industry, chromium is one of the primary elements that must be accounted for in order to preserve environmental and public health. Currently, 90% of global leather manufacturing relies on chrome-tanning owing to its stabilizing properties, allowing leather to resist microbial degradation as well as temperature variation, sweat exposure, and other environmental stressors.

However, only 20% of the material can be converted into leather while 25% becomes waste, primarily introduced into wastewater. Left untreated, this wastewater can cause significant damage to human health and the environment. As such monitoring chromium is necessary to ensure the safety of both the leather itself and leather tanning effluent to protect people, ecosystems, water supply, and agricultural land from unsafe levels of chromium exposure while also meeting local regulations.[1]

Unfortunately, traditional methods of chromium determination, such as graphic furnace atomic absorption spectrometry and flame atomic absorption spectrometry are time-consuming and destructive, requiring extensive sample preparation. In order to develop a more rapid, reliable, and user-friendly chromium determination method, researchers are turning to UV-Vis spectrophotometry.

Chromium-containing wastewater can wreak havoc on agricultural lands and introduce the toxic material into the food supply.
Image Source: Pexels user McDobbie Hu

What Is Chromium?

Chromium is a naturally occurring element present in animals, plants, soil, and volcanic gas.[2] Although trivalent chromium (CR III) is an essential nutrient involved in maintaining protein, glucose, and fat metabolism, hexavalent chromium (Cr VI) is a toxic substance that can lead to a host of health problems, including:

- Respiratory problems
- Gastrointestinal effects
- Liver and kidney damage
- Immune system suppression
- Cancer
- Neurological damage

Despite the toxicity of chromium, it is an essential part of multiple major industries, including steel manufacturing, wood preservation, chrome plating, dye and pigment manufacturing, and leather tanning. These manufacturing processes may cause both direct exposure to workers and consumers via contact with the product itself as well as **introduction of chromium in the water supply**, soil, agricultural products, and air.

UV-Vis spectrophotometric evaluation of chromium can help the leather industry protect fragile eco-systems and the water supply.
Image Source: Pexels user Wolfgang Moritzer

UV-Vis Spectrophotometric Methods of Chromium Determination

UV-Vis spectrophotometry offers a rapid, simple, non-destructive method of chromium determination in both leather and **leather tannery effluent**. By monitoring the spectra of leather and wastewater, spectral analysis allows operators to quickly and easily measure chromium levels to evaluate safety. Moreover, this method is able to produce reliable readings of chromium without interference from other chemical contaminants, such as lime, sulfuric acids, and salts. According to a 2009 study by researchers from Hebron University, "UV-Vis spectrophotometric measurements can be used as a quality control technique for monitoring the treatment and recycling of chromium solution in the leather industry."[3]

A study published in *Chemical Monthly* investigating the efficacy of a UV-Vis spectrophotometric method for analyzing chromium levels in leather itself found that not only is the method effective, but it is "the most suitable method: other methods suffer from severe matrix effects arising from high concentrations of mineral acids and electrolytes."[4] The method was praised for its ease of use, high level of accuracy, and broad applicability.

UV-Vis spectrophotometric chromium determination methods is also playing an integral role in the evaluation of new treatment methods that seek to decrease chromium levels in leather tanning wastewater. A 2011 study, for example, introduced an innovative chromium removal process using solid limestone waste from the stone cutting industry that may offer new possibilities for enhancing environmental and public health protections in areas where standard treatment processes cannot easily be used or do not offer sufficient chromium removal.[5]

Using UV-Vis spectrophotometry, the researchers were able to determine that the limestone waste method resulted in "nearly full removal of chromium" within days. As awareness of the chromium-related environmental and public health concerns grows and regulation expands, UV-Vis spectrophotometry will continue to be an invaluable tool to analyze and refine treatment methods and promote safe practices within the leather tanning industry.

HunterLab Quality

HunterLab has been a pioneer in the field of spectrophotometry for over 60 years. Today, we offer a comprehensive range of UV-Vis spectrophotometers to meet the needs of our customers across

industries and facilitate the evaluation of products, processes, and industrial waste. Our modern portable, benchtop, and in-line instruments provide operators with extraordinary precision, flexibility, and user-friendly operation to ensure that spectral analysis can be performed quickly, easily, and with the highest degree of accuracy. **Contact us** to learn more about our renowned spectrophotometers, advanced software packages, and world-class customer support services.

1. "Chromium in Drinking-water," 1996,

   http://www.who.int/water_sanitation_health/dwq/chemicals/chromium.pdf

2. "Chromium Compounds,"

   2000, https://www3.epa.gov/airtoxics/hlthef/chromium.html

3. "Monitoring Chromium Levels in Tannery Wastewater," May 27, 2009,

   https://www.aqa.org.ar/pdf9702/9702art7.pd

4. "Determination of Extractable Chromium From Leather," January 2009, https://www.researchgate.net/publication/225684164_Determination_of_extractable

   _chromium_from_leather

5. "Treating Leather Tanning Wastewater with Stone Cutting Solid Waste," December 12, 2012,

   http://onlinelibrary.wiley.com/doi/10.1002/clen.201000431/abstract