TOC Key to Bright Nickel Purity

Today's demands for high quality bright, leveled and ductile nickel deposits are greater than ever. Automotive and the motorcycle industries have set the pace for this increased quality. One has only to look at a new Harley Davidson and calculate the square footage of nickel chromium it displays to prove the point. They know that nickel chromium sells bikes. In addition to factory bright work, very few bikes leave the dealer without adding an additional $2,000.00 to $3,000.00 of plated accessories. Square footage has increased on automobiles, the trend is continuing. Top line freight carrying tractors sport large nickel chromium grills. This backs up a phrase I have used for years **"Nickel Is Class".**

Producing this high quality requires that plating baths be in chemical balance and a high state of purity. The inorganic balance is simple; however the organic purity has always been a guessing game. We know that an organically clean bath produces the ideal deposit. As contamination increases, efficiencies decrease. For metallics, removal is simple, oxidize, precipitate or electroplate out. Organic contamination presents a more complicated problem. Organic contaminants are difficult if not impossible to identify. The source of origin may be from insufficient cleaning, impacted polishing compound remaining in holes and crevasses, and soils on the parts that are carried into plating baths. In addition to drag-in contaminants, there are break-down products produced by electrolyses of additives.

Traditional Methods

Traditional treatments for organic contamination has been the bi-annual carbon treatment during Christmas and Fourth of July shutdowns. Plating baths are treated mainly because of the seasons. When questioned why, the usual response is "It really can't hurt". Standard carbon treatments consisted of pumping the bath to storage, dumping in carbon, mixing well and let settle. Filter back into the plating tank and your ready to go. If we though the bath was really contaminated, we dumped in some hydrogen peroxide and maybe even potassium permanganate. Now we cleaned up all the bad stuff. or have we? I have run Hull cell test on baths before and after these holiday rituals and found very little difference. They did remove all of the wetting agents. Carbon treatments are costly, first in the loss of solution ranging from 5 to 10 %. Second is labor, which is usually done on overtime, third is the replacement of additives removed.

TOC "Total Organic Content"

Today with the aid of TOC analysis we are able to determine the total amount of organics both good and bad and maintain purity. TOC analysis offers the ability to track organic contamination and treat when needed with confidence of cleaning up the bath. Plating baths consist of both inorganic and organic materials. Maintaining these materials in a state equal to a new baths values, we can produce plating equal to that value.

Knowing the TOC of a new and clean bath we may surmise that an increase is from contaminants, we can now take the proper action.

Nickel Bath TOC Values ppm **New Bath**

Bright Nickel SAS base …….. 3,000 ppm
Semi-Bright Nickel …… 500 to 1,000 ppm
Microporous Nickel …… 2,000 ppm

Organic Additive Additions

Secondary brightener SAS ……. 0.1% 677.0 ppm
Secondary brightener PPS …… 0.1% 72.0 ppm
Primary brightener ……..…… 1.0 % 648.0 ppm
Carrier brightener …….
Wetting agent ……... 1.0% 683.0 ppm
Purifiers …… 0.1% 48.0 ppm

Dispersing agent …… 0.125% 112.0 ppm
City tap water ……. 11.0 ppm
Values between vendors may vary slightly.

TOC CONTRIBUTORS

Ni ……. 0.0

$NiSO_4$ ……. 0.0

$NiCl_2$ ……. 0.0

H_3BO_3 ……. 0.0

Primary Brightener ..... 4.00% - 2592.0

Secondary Brightener …… 0.20% - 144.0

Carrier Brightener ……. 400.0

Wetting Agent ……0.20% 136.0

Dispersing Agent ……..	0.0
Purifiers ……..	48.0
Additive Breakdown Products …….	0.0
Miscellaneous …….	0.0
City Water (York, PA) …….	12.0
Total TOC of a new bright nickel bath…….	3,332.0

Organic Contaminants

Oils	Pitting, Blotches, Poor Adhesion
Greases-	Pitting, Blotches, Poor Adhesion
Polishing Compounds	Pitting, Blotches, Poor Adhesion
Additive Break-down Products	Clouds Hazes Pitting, Stardust, Poor Chromium Receptivity Drop off of Step Decrease In Additives Efficiency.

Removing Organic Contaminates

Now that we know what we are looking for, a proper carbon treatment may be conducted. A newly made up PPS bath will have a TOC of ±3,000 ppm. Normal operating range would be 3,000 to 25,000 ppm. We would conclude from this that TOC over 25,000 ppm would constitute a bath in need of purification. High levels of brightener, wetters, and purifiers will raise the TOC levels and must be factored in. They will fall into the range of good TOC. Assuming the additives are at there proper concentration and the TOC is over 25,000 ppm the bath would be in need of purification.

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TOC analysis would eliminate performing a carbon treatment because of the season. Conducting Hull cell test in conjunction with TOC analysis a proper treatment may be conducted. Factors involved in proper carbon treatments consist of carbon, hydrogen peroxide, potassium permanganate and pH. Organics are removed at specific pH levels with varying amounts of oxidizing agents. They are then absorbed by carbon. Treatments should be performed
at the following levels.

Treating a contaminated bath to the following conditions, followed by Hull cell test we are able to determine the exact treatment required.

1. Straight carbon at operating pH (4.00)
2. Straight carbon at low pH (3.0)
3. Carbon with hydrogen peroxide high and low pH
4. Carbon with potassium permanganate high and low pH.

By performing TOC analysis on each treated sample the most effective treatment may then be performed with confidence of removing all harmful organics. We have discussed the value of TOC testing on nickel plating bath. TOC may be used on any plating bath where organic additives are use.

A one time analysis of TOC of a plating bath may tell the organic content, be it high or low. The real value of TOC is to use as a tracking device of organic contamination. A weekly analysis informs you of purity levels as they rise and fall. As you observe these trends you may act accordingly, performing treatments as needed.

Tracking TOC in a high volume, high quality nickel plating operation yielded the following values in ppm after six months of operation.

Date	**SF Nickel**	**Bright Ni**	**Microporous Ni**
12-07-06	250	20,305	16,061
12-15-07	382	21,300	16,358
1-12-07	480	22,431	17,889
1-19-07	548	21,740	18,012
1-26-07	610	21,462	18,112
2-21-07	409	21,903	15,872 Carbon Treat
3-02-07	537	22,941	18,053
3-09-07	962	23,198	18,027
3-16-07	665	24,112	18,852
3-30-07	627	20,405	16,000 Carbon Treat
4-13-07	637	18,800 Carbon treat	14,100
4-20-07	716	18,700	13,700
4-26-07	699	18,850	14,350
5-11-07	780	17,900	13,650

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TOC Analyzer Courtesy

The TOC analyzer totally automatic, easy to maintain, analysis are simple to perform. Depending on the concentration of material, being tested a sample is placed in a beaker as is or diluted. The program is set to go; results are ready in 5 minutes with a direct reading and printed readout. TOC analysis is useful on any plating bath where organic additives are used. They are especially useful in checking purity of water, both in rising and waste treatment. Approximate cost is per unit is $20,000.00

