Stellar Solutions

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Re: York University
Standards and Guidelines for Water

Dear Client,

Stellar Ltd is proud to submit the following case study concerning The Standards and Guidelines for Water in Ontario. This report was prepared based on the terms outlined by Professor Ahmed K. Eldyasti and aims to accurately address the topic.

Please find on the following pages: a background, relevant research, implications, and the analysis proposed.

Please do not hesitate to reach out with any questions or concerns. Our offices have been instructed to handle your call with the utmost care.

Cordially,

Nima Young

Nima Young
Director
Stellar Solutions

ENVIRONMENTAL STANDARDS

A Case Study on The Standards and Guidelines for Water

Prepared by: Nima Young

Stellar Solutions

Prioritizing Sustainability

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1.0 INTRODUCTION

The Standards and Guidelines for water management in Ontario are specified in a publication available online. This comprehensive document is named *Water management: policies, guidelines, provincial water quality objectives*, and is updated regularly. The hosting party is ontario.ca and the copyright for this content is registered and held under *Queen and King Printer for Ontario*, registered in 1994. The report generated by Stellar Solutions (hereafter referred to as **The Company**) cites this article (hereafter referred to as **The Policies**) in presenting the selected case study.

The case study presented references a secondary case study executed in The USA (hereafter referred to as **The Guide**). The Guide is available online under the publication titled: *A Case Study In Meeting Present and Future Water Quality Standards,* written by Edward L. Von Stein and Elizabeth F. Wadge. In the following pages, you shall find a thorough breakdown of the case study generated by The Company assessing Standards and Guidelines for Water, closely following the facts enclosed within The Guide. Findings are cross referenced by The Policies when appropriate and applicable.

The Guide defines regulatory bodies and their roles in maintaining the quality of water.
The case study follows the operations of the subject, referred to as *Client,* a metal finishing firm headquartered in central Connecticut. The Client intends to open a new plating facility, and thus, The Guide aims to assess effluent requirements and proposes avenues in reaching an optimal outcome for this project. Central to the case study is the expected values of effluent requirements which are gathered through surveys tendered to regulatory personnel. Due to the lack of consensus, Table I, available within the Appendix, summarizes the limits set by the EPA on effluent limitations and the projected values which are reached through normalization of gathered data. These are named most stringent and most probable respectively, with the most probable values being a median expression and conservative figures by nature.
In summary, The Guide is a case study on the estimated effluent limitations, and three treatment technologies which are promising in satisfying these limitations.

Throughout the study, wastewater segregation categories and constituents are summarized. Collected data are available within Table II, and the current limits for effluent quality for metal finishing wastes are available within Table III. All tables are enclosed within the Appendix. Furthermore, The Guide executed a Bench-Scale Treatment Study as a projection of the success of treatment for the project, the results of which are available within Table IV. The Guide covers some alternatives for the executed study which are briefly discussed in the discussion section on page three.

2.0 BACKGROUND

2.1 Definitions

MOEE: Ministry of Environment and Energy. (**Ministry**)
OWRA: Ontario Water Resources Act.
EPA: Environmental Protection Agency.
Certificate of Approval: Sealed document representing a specific permission granted to the Ministry to discharge contaminants to the environment [3]. (**Approval)**

2.2 Relevance of The Guide

Canada and The USA, having one of the worlds most effective, and long standing environmental partnerships, serve as a good reference for the study of standards concerning water. The border of these two nations include eighty percent of all great lakes, major airsheds, and migratory routes for wildlife [1]. The guiding case study then, carried out in The USA, serves as an appropriate reference for the execution of this report.

2.3 Rights and Responsibilities

The Ministry gets its powers dually from OWRA and EPA. OWRA, as the primary act influencing Ontario, gives the Ministry great power to regulate water supply, sewage disposal and to control sources of water pollution. The Ministry has the right and responsibility of supervising all surface and ground waters in Ontario. The EPA acts as a guideline for the prohibition of discharge of all contaminants to the environment, including water except where permitted by Approval.

Important to note is the existence of other federal and provincial jurisdictions, most notably Ontario Ministries of Natural Resources, Health and Agriculture (Referred to most commonly as OMNRHA), Food and Rural affairs, Conservation Authorities and the Federal Departments of Fisheries and Ocean and Environment Canada (FDFOEC) which are responsible for some other aspects of water management.

The Ministry and the acts influencing its power is the most relevant authority figure with respect to the current case study and, are therefore, cited frequently.

3.0 DISCUSSION

3.1 Facts and Implications

The wastewater segregation categories and constituents are summarized as follows:
1- Cyanide: Copper strip rinsewaters, reverse current clean, copper plating, silver plating.
2- Nuvat: Nuvat alkaline soak contain chelates. *
3- Electroless Nickel: Electroless plating solution is also chelated.
4- Nickel: Watts nickel plating, electroless nickel, nickel strike -must be precipitated at high pH.
5- Gold: Pumped through resin column for gold reclaim -discharged to cyanide rinse line.
6- Acid: Acid baths, pretreated chelated nickel, and cyanide wastes collected for pH adjustment.
7- Floor Spills: Drag-out minimization technique expected to reduce spillage.
*Chelates interfere with the precipitation of nickel and other metals.

Type	Count	Solution	Implication
Electroless Nickel Plating Tank	2	Dumped when contaminated	Worked as expected
Rinse Tank	1	Dumped when contaminated	Worked as expected
Watts Nickel Bath	1	Dumped when contaminated	Worked as expected
Nickel Strike Bath	1	Dumped when contaminated	Worked as expected

It is found that the conventional system employed by The Guide for their Client will work as expected; the system designed and reviewed will meet and satisfy all limitations set out by regulating bodies concerning metal finishing effluent in terms of both rate and quality.

3.2 Connection to Ontario

Due to the striking similarities between the contributing regulations between Canada and The USA [3], alongside the mechanisms employed for metal finishing industries, the system deigned and reviewed by The Guide are expected to satisfy the conditions and limitations set out for this industry. Should this method be employed in Ontario, metal finishing industries will benefit from the effluent strategy reviewed through this case study.

3.3 Future Projections

The existing plant was permitted in 1981 by DEP, and violated the limits by approximately 30% for the years, 1983, 1984, and 1985. The specific concentration and violation frequency is available within table V. The conventional system designed and reviewed within this report is expected to meet permit limits consistently.

4.0 CONCLUSION

This case study, presenting the facts enclosed within the publication by The Guide aims to review the strategies employed for meeting effluent limitations by a metal finishing company, The Client, based in The USA. Following a brief summary of regulatory bodies and legislations influencing and ultimately responsible for upholding standards for water, the strategy employed has been assessed and presented herein.

For closer examination of the contents of The Guide, or for any specific informations on regulations, please refer to the references posted below. The USA and Canada, having an effective and longstanding environmental relationship, are linked together by way of regulatory bodies. As such, the review presented by The Guide is highly applicable to the political and regulatory climate of Ontario and virtually all of Canada. Considering the extensive overlap between the mechanisms employed for metal finishing firms, including but not limited to activities involving copper, gold, lead, nickel, silver, and tin, the findings presented within this study could be replicated for the use of metal finishing firms operating within Ontario.

The consensus reached implies that the designed system for the firm under review by The Guide will effectively satisfy all limitations and conditions imposed by regulators consistently. Stellar implores any and all companies aiming to replicate these measures to do so diligently and with due care. For the most effective assessment of specific situations presented to your company, please feel free to consult a firm near you.

In closing, The Company appreciates your time in considering this case study, its efforts in familiarizing you with the fundamentals involved in metal finishing regulations and hopes to have contributed value to your endeavour. For any further questions or concerns, please feel free to contact us, we would be delighted to help in any way we can.

REFERENCES

[1] “EPA Collaboration with Canada,” EPA, https://www.epa.gov/international-cooperation/epa-collaboration-canada (accessed Apr 29, 2024).

[2] E. L. Von Stein and E. F. Wadge, “A case study in meeting present and future water quality standards: 8,” Taylor & Francis, https://www.taylorfrancis.com/chapters/edit/10.1201/9781351069380-82/case-study-meeting-present-future-water-quality-standards-edward-von-stein-elizabeth-wadge (accessed Apr 29, 2024).

[3] “Water management: Policies, guidelines, provincial water quality objectives,” ontario.ca, https://www.ontario.ca/page/water-management-policies-guidelines-provincial-water-quality-objectives (accessed Apr 29, 2024).

APPENDIX

Table I. Estimated Effluent Limitations

	Concentrations, mg/L	
	Most Stringent[a]	Most Probable[a]
Copper	0.0056	0.07
Nickel	0.056	0.10
Lead	0.0008	0.005
Silver	0.0012	0.004
Cyanide (Total)	0.0035	0.008
Source	b	c

[a]Hardness at 50 mg/L as $CaCO_3$, except cyanide.
[b]Reference [6]
[c]Authors' estimate.

Table II. Wastewater Characteristics [5]

Waste	Principal Contaminant	Concentration	Flow Rates Max, gpm	Flow Rates Avg, gpd	Frequency
Cyanide	CN = 400 mg/L	Rinses	38.5		
	pH = 10+	Baths		45	≤ 1/mo
Nuvat	pH = 11	Rinses	17.5		
	Some Metals	Baths		60	≤ 1/wk
Electroless Nickel	pH = 5	Rinses	1.5		
	(e)Ni = 50 mg/L	Baths		4	≤ 1/2 mo
Nickel	Ni = 1000 mg/L	Rinses	25.5		
	Chelating Agents	Baths		40	Varies
Gold	–	Rinses	5.0	–	–
Acids	pH	Rinses			
		& Neutralization Baths	95.5	175	Varies
Floor Spills	–	–		50	Varies
Total				46000 gpd	

APPENDIX

Table III. Current Limits

Parameter	Maximum Average Daily Concentration (mg/L)
Copper	1.0
Gold	0.1
Lead	0.1
Nickel	1.0
Silver	0.1
Tin	2.0
Cyanide (amenable)	<0.1

Table IV. Outline of Conventional Treatment System as Designed [5]

Waste	Treatment	pH	Detention Time Minutes	Predicted Results[a]
Cyanide	Alkaline Chlorination • CN I • CN II	8.5	<20 60	0.04 mg/L ND
Nuvat	Calcium Chloride @ 2 lb/12 gal; Nickel	6	–	Requires Nickel Treatment
Nickel	Sodium Hydroxide	12	20	0.1 mg/L
Electrodes	Proprietary Chemicals; Nickel	–	20	Requires Nickel Treatment
Acids	Neutralization • Sodium Hydroxide • Sulfuric acid	6.5–8	30	pH 6.5–8
Gold	Ion Exchange Recovery's CN I & II	–	–	0.1
Floor Spills	Batch, as required			–

[a]Authors' analyses.

APPENDIX

Table V. Historic Probability of Meeting Limits[a]

	mg/L Limit	1983		1984		1985	
		x[b]	f[c]	x[b]	f[c]	x[b]	f[c]
Copper	1.0	4.5	1.0	2.2	0.8	1.4	0.7
Gold	0.1	0.0	0.0	0.1	0.3	0.1	1.0
Lead	0.1	1.0	1.0	0.2	0.6	0.2	0.9
Nickel	1.0	3.0	1.0	3.0	1.0	1.7	0.8
Silver	0.1	0.0	0.0	0.1	0.3	0.0	0.0
Tin	2.0	2.5	0.3	1.0	0.0	0.9	0.0
ACN	<0.1	0.0	1.0	0.2	0.7	0.1	0.3
TSS	20.0	21.3	0.5	10.4	0.2	4.0	0.0

[a]Author's analysis.
[b]"x" is average of monthly grab samples.
[c]"f" is frequency of exceedance, i.e. = no. of months above limit/12.

Table VI. Metal Solubilities [8]

	Hydroxide	Sulfide Concentrations, mg/L	Column 1 / Column 2
Copper	2×10^{-2}	2×10^{-13}	1×10^{11}
Gold	–	–	–
Lead	2×10^{0}	6×10^{-9}	3×10^{8}
Nickel	7×10^{-1}	6×10^{-8}	1×10^{7}
Silver	2×10^{-1}	2×10^{-12}	5×10^{12}
Tin	–	–	–

Table VII. Cost Comparisons [4,7,8,9,10]

	Conventional System	Ion Exchange	Sulfide Precipitation	Ultrafiltration
Capital Cost				
Unit Capital Cost[a]				
$/gpm	3,700	33,500	3,000	27,000
$/gpd	3	23	2	19
Annual Operating Cost[a]				
Unit Annual Cost				
$/gpy	0.02	0.08	0.02	0.03

[a]Unit cost basis: 100 gpm; 144000 gpd; 12000000 gpy.