

Original Research

Investigation of the Complex of Cream Instruments in the Steel and Oil Industry

Martin Zbuzant*

Centre for Sustainable Infrastructure, Department of Civil and Construction Engineering, Swinburne University of Technology, Melbourne, Australia

ARTICLE INFO

Article history

Submitted: 07 September 2020

Revised: 12 October 2020

Accepted: 14 November 2020

Published: 14 December 2020

Manuscript ID: JEIRES-2012-1009

KEYWORDS

Cream

Capacity

Environmental Issues

Industry

Ions

ABSTRACT

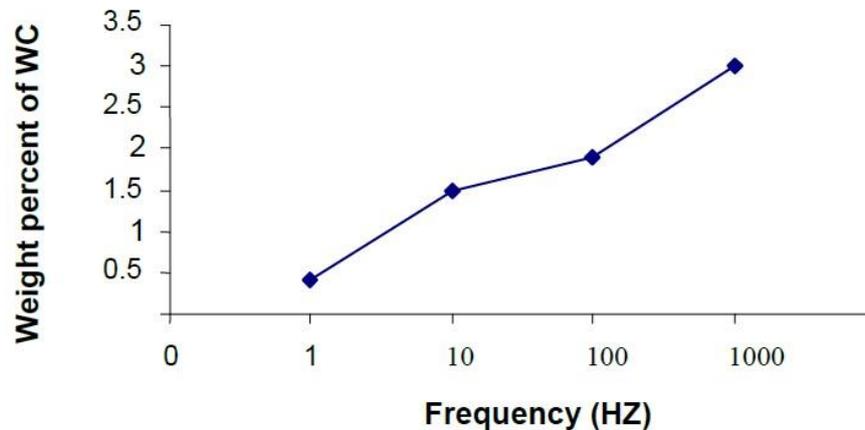
In recent years, the complexing mechanisms of various organic compounds, especially carboxylic acids in trivalent cream baths have been studied. Complexes with a certain minimum stability as well as a high thermodynamic stability are desirable. In this case, the additional potential increases the tendency of the thermodynamic stability of the trivalent cream complex to regenerate. Aqueous complexes have minimal thermodynamic stability while also having high kinetic stability for neutrality. Complexes such as glycolic and formic acid have a high creaming power. For several years, the use of a trivalent solution instead of a hexavalent ion has been considered in cream plating. The first process of decorative deposition of trivalent cream began in 1975 in the United Kingdom and in 1976 in the United States. Environmental issues, safety and benefits are the factors of industrialization of this process. Hexavalent cream ions are carcinogenic and cause sores on the skin. The toxicity of trivalent cream ions is about 100 times lower than that of hexavalent cream ions. Trivalent cream processes produce less steam than hexavalent cream. Therefore, there is no need for a gas purifier. Effluent treatment in this process is reduced tenfold because the concentration of trivalent cream is one tenth of its concentration in hexavalent processes. All of this has led to the development of cream plating based on trivalent cream compounds.

* Corresponding author: Martin Zbuzant

✉ E-mail: martinzbuzant1994@gmail.com

© 2020 by SPC (Sami Publishing Company)

GRAPHICAL ABSTRACT



Introduction

Ingredients for trivalent cream baths include:

- (1) Trivalent cream salt in the form of cream sulfate or cream chloride.
- (2) Organic complexing agent such as acetate, formate and citrate.
- (3) Conducting agents and conductive salts such as ammonium sulfate, sodium sulfate and potassium sulfate.
- (4) PH controller (boric acid).
- (5) Inhibitor of oxidation (formate ion) [1-3].

Features of plating bath composition

The composition of the plating bath should have the following conditions:

- (1) It should contain enough sedimentary metal.
- (2) It has good electrical conductivity to reduce energy consumption.
- (3) The cover should not be affected by atmospheric conditions.
- (4) It has enough capacity to form a suitable anode so that the amount of metal in the solution remains balanced.

(5) Has the ability to create a firm and smooth cover.

(6) It has high throwing power [4-6].

The effect of the work cycle In order to investigate the effect of work cycle on the participation of nanometer particles of tungsten carbide in composite coatings, different coatings were produced in different values of 10, 30, 50, 70 and 90 work cycles [7-9].

Figure 1 shows the changes in the weight percentage of tungsten carbide in the Cr-WC composite coating in terms of work cycle. As can be seen, the presence of particles in the coating has increased with decreasing work cycle. The reason for this can be due to the increase in shutdown time and consequently the increase in the probability of particles reaching the cathode surface (poor particle absorption) with a decrease in the work cycle [10-14]. Particles that reach the cathode surface during the off time are buried in the coating at the next light time. As a result, reducing the work cycle leads to increasing the

weight percentage of particles in the coating. In pulsed current, the current is interrupted at certain intervals, so in this interval, which is called the off time of the current, the deposition of worm ions does not occur [15-19]. On the other hand, free ions of worms and ions adhering to the surface of particles compete with each other to reach the surface of the cathode. At currents, there is electrophoretic movement of ions towards the cathode. Worm ions can reach the cathode surface more easily than ions that adhere to the particle surface due to their greater mobility. However, due to the lack of electrophoretic motion of ions, the ions attached to the particles have a better chance of reaching the cathode surface by turbulence and diffusion, so the number of particles that can reach the cathode surface increases due to the quenching time. Another point is that increasing the work cycle causes

larger particles to enter the coating. Because at longer light times, particles that reach the cathode surface anyway are quickly trapped and buried by the reduction of worm ions. In addition, at low extinction times, the particles are less exposed to the hydrodynamic shear force of the solution and the suspended particles in it, and as a result, their probability of slowing down is reduced, and vice versa, at low light times, the particles are exposed to hydrodynamic force. It is located and its large particles are easily removed from the surface of the cathode and only small particles enter the coating [20-23].

Impact of pulse frequency

Four frequencies of 1, 10, 100 and 1000 Hz were used to evaluate the frequency. As can be seen, with increasing frequency up to 1000 Hz, the particle coagulation rate increases [24-26].

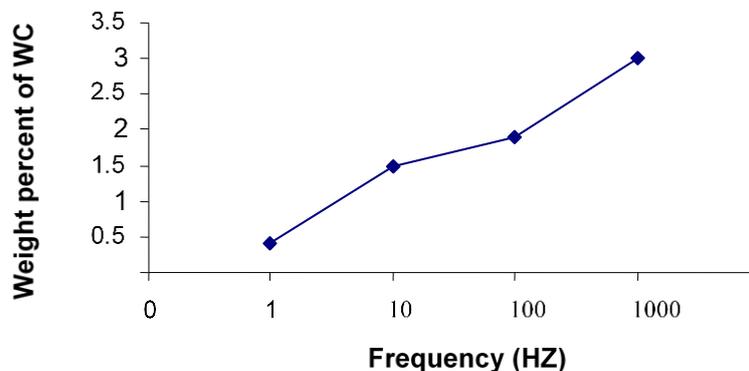


Figure 1. Graph of weight changes of tungsten carbide in Cr-WC composite coatings in terms of frequency, in plating bath with particle concentration of 10 g/lit, SDS 1 g / lit, 1 g/lit saccharin, pH 2.5, working cycle 50% , Current density 8, temperature 27 and time min 100

As mentioned earlier, particles have a better chance of reaching and being on the cathode surface during the shutdown time. Frequency reduction does not change the percentage of

total off-time and brightness, so the chance of particles reaching the cathode does not change, but on the other hand, as the frequency decreases, off-time times become longer,

causing poor bonding and slowness [25-27]. They are driven by the prevailing hydrodynamic current at the time of shutdown. This can be the reason for the reduction of particles in the coating at low frequencies. But the point to be noted is that with increasing frequency, the extinction times are shorter, so more agglomerate particles enter the coating because at long extinction times the agglomerate particles are removed from the double layer due to hydrodynamic currents. And cannot get inside the cover. Investigation of the effect of effective parameters on hardness and wear behavior of Cr-WC nano composite coatings [28-30]. The results of the previous section showed that the addition of SDS and saccharin as well as the change of plating parameters are effective on the coating morphology and co-deposition of ceramic particles in the coating and grain size. In this section, the effect of these parameters

on the hardness and wear behavior of the coating is investigated [31-34].

Effect of WC particle concentration in plating bath

Figure 2 shows the micro hardness diagram of pure cream coatings and Cr-WC composite coatings in terms of different concentrations of WC in the bath [35-37]. The micro hardness of pure cream coating was measured to be HV 560. As it was shown, with increasing the concentration of WC in the bath, the amount of particle coagulation in the coating increased and at high concentrations of tungsten carbide powder, the agglomeration of the particles increased, which reduced the amount of hardness. In fact, the particles increase the micro hardness of the coating after entering the coating through the dispersion mechanism of hardness [38-41].

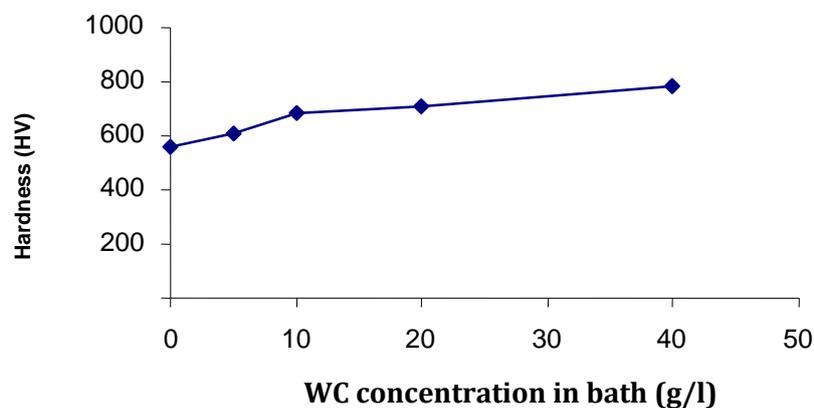


Figure 2. Micro hardness diagram of pure cream coating and Cr-WC composite coating according to different concentrations of WC in plating bath with 50% working cycle, frequency 10 Hz, SDS. The highest abrasion rate is related to pure cream coating at 0.27 mg/m

With more co-deposition of WC particles in the coating, the wear rate decreases and reaches 0.06 mg/m for the composite coating produced

in the bath containing 40 g/lit [42-46]. As can be seen, with increasing the amount of WC in the bath, the amount of abrasion rate

decreases, which is in agreement with the degree of co-deposition of particles in the coating and the micro hardness of the coating. In other words, as the concentration of particles in the solution increases, the amount of WC coagulation in the coating increases, the surface roughness decreases and the coating hardness increases, and the worm becomes finer, which together reduces the wear rate [47-50].

Translation results

By increasing the amount of WC in the plating bath from 10 to 40 g/l, as seen in Figure c, the level of abrasion is smoother and the dents on its surface are much less. This could be due to the presence of more WC particles in the coating. Effect of SDS surfactant concentration. The reason for this could be the increased co-deposition of WC particles in the coating [51-56].

Conclusion

With increasing the concentration of SDS in the bath from 0.2 to 1 g/l, the amount of particle co-precipitation increases, but with increasing the concentration from 1 to 2 g/l, no change in the particle co-precipitation is observed and increases the hardness of the coating. The reason for this phenomenon may be that SDS also acts like saccharin and reduces the grain size as well as the brittleness of the coating, which in turn increases the hardness of the coating. As can be seen in this figure, by increasing the SDS concentration from 0.2 g/lit to 1 g/lit 1, the wear rate decreases from 0.22

mg/m to 0.16 mg/m, which is due to more particle co-precipitation. And increase the micro hardness of the coating and ultimately reduce the wear rate. Also, despite increasing the concentration of SDS to 2 g/lit, the coating hardness increases. The wear resistance of the coating decreases. To justify this, as mentioned above, increasing the SDS concentration above the optimum limit leads to brittleness of the coating, which reduces the wear resistance of the coating. Also, with increasing SDS concentration, the bond between the particles and the substrate may not be established well because after the WC particles are placed in the coating, there is still some SDS on them, which leads to easier removal of particles from the coating surface during testing. Abrasion and as a result the wear rate increases.

References

- [1]. M. Pour Kiani, M. Pourjafari Jozam, M. Pourjafari Jozam, *Int. J. Adv. Stu. Hum. Soc. Sci.*, 2020, 9(2): 150
- [2]. M. Alikhani, J. Khodayari, M. Dehnavi, J. Verij kazemi, *Int. J. Adv. Stu. Hum. Soc. Sci.*, 2020, 9(2): 165
- [3]. S. Ketabi, A. Sadeghi, *Int. J. Adv. Stu. Hum. Soc. Sci.*, 2020, 9(1): 1
- [4]. S. Salehi-Kordabadi, S. Karimi, M. Qorbani-Azar, *Int. J. Adv. Stu. Hum. Soc. Sci.*, 2020, 9(1): 21
- [5]. M.R. Rahnama, M. Ajza Shokouhi, A. Heydari, *Int. J. Adv. Stu. Hum. Soc. Sci.*, 2020, 9(1): 37
- [6]. H. Jenaabadi, B. Ruzrokh, *Int. J. Adv. Stu. Hum. Soc. Sci.*, 2020, 9(1): 63

- [7]. S. Rahimipour, *Int. J. Adv. Stu. Hum. Soc. Sci.*, 2020; 9(1): 72
- [8]. K. Hashemi Fard, *Int. J. Adv. Stu. Hum. Soc. Sci.*, 2020, 9(1): 84
- [9]. G. Zaeri, *Int. J. Adv. Stu. Hum. Soc. Sci.*, 2019, 8(4): 310
- [10]. M. Shafaei, H.A. Bahramzadeh, *Int. J. Adv. Stu. Hum. Soc. Sci.*, 2019, 8(4): 321
- [11]. B. Sahranavard, R. Hajhosseini, *Int. J. Adv. Stu. Hum. Soc. Sci.*, 2019, 8(4): 332
- [12]. S. Abdollahyar, A. Masihpoor, *Int. J. Adv. Stu. Hum. Soc. Sci.*, 2019, 8(4): 350
- [13]. M. Fathi Rkabdary, *Int. J. Adv. Stu. Hum. Soc. Sci.*, 2019, 8(4): 362
- [14]. S.M. Sajjadi, S. Ansari, *Int. J. Adv. Stu. Hum. Soc. Sci.*, 2019, 8(4): 369
- [15]. M.R. Rahnama, A. Bidkhori, A. Kharazmi, *Int. J. Adv. Stu. Hum. Soc. Sci.*, 2019, 8(4): 383
- [16]. M. Gareche, S.M. Hosseini, M. Taheri, *Int. J. Adv. Stu. Hum. Soc. Sci.*, 2019, 8(3): 223
- [17]. A. Olah Erfani, M. Almasi, H. Reshadatjoo, *Int. J. Adv. Stu. Hum. Soc. Sci.*, 2019, 8(3): 241
- [18]. M. taghi Mahmoudi, M. Azar, R. Bahrami, *Int. J. Adv. Stu. Hum. Soc. Sci.*, 2019, 8(3): 255
- [19]. H.g. Moniri, N. Dohniyatkar, *Int. J. Adv. Stu. Hum. Soc. Sci.*, 2019, 8(2): 148
- [20]. S.N. Jelodarloo, E. Nazari, Z. Hatami, K. Nouri, S. Nazari, *Int. J. Adv. Stu. Hum. Soc. Sci.*, 2019, 8(2): 158
- [21]. Z. Hatami, S.N. Jelodarloo, E. EmamgholizadehTakle, E. Nazari, A. Hatami, *Int. J. Adv. Stu. Hum. Soc. Sci.*, 2019, 8(2): 168
- [22]. E. Nazari, A. Derakhshan, K. Nouri, S. Nazari, S. Naseramini Jelodarloo, *Int. J. Adv. Stu. Hum. Soc. Sci.*, 2019, 8(2): 178
- [23]. A. Bozorgian, S. Zarinabadi, A. Samimi, *Journal of Chemical Reviews*, 2020, 2(2): 122
- [24]. A. Bozorgian, S. Zarinabadi, A. Samimi, *Chemical Methodologies*, 2020, 4(4): 477
- [25]. A. Samimi, *Progress in Chemical and Biochemical Research*, 2020, 3(2): 140
- [26]. A. Bozorgian, Z. Arab Aboosadi, A. Mohammadi, B. Honarvar, A. Azimi, *Journal of Chemical and Petroleum Engineering*, 2020, 54(1): 73
- [27]. S.V. Mousavi, A. Bozorgian, N. Mokhtari, M.A. Gabris, H.R. Nodeh, W.A. Ibrahim, *Microchemical Journal*, 2019, 145: 914
- [28]. A. Bozorgian, *Progress in Chemical and Biochemical Research*, 2020, 3(2): 169
- [29]. A. Bozorgian, Z. Arab Aboosadi, A. Mohammadi, B. Honarvar, A. Azimi, *Eurasian Chemical Communications*, 2020, 2(3): 420
- [30]. A. Bozorgian, Z. Arab Aboosadi, A. Mohammadi, B. Honarvar, A. Azimi, *Progress in Chemical and Biochemical Research*, 2019, 31
- [31]. N. Farhami, A. Bozorgian, *In Int. Conf. on Chem. and Chem. Process IPCBEE*, 2011, 10: 223
- [32]. A. Bozorgian, N.M. Nasab, H. Mirzazadeh, *World Academy of Science, Engineering and Technology International Journal of Materials and Metallurgical Engineering* 5, 2011, 1: 21
- [33]. A. Bozorgian, *Advanced Journal of Science and Engineering*, 2020, 1(2): 34-39
- [34]. J. Mashhadizadeh, A. Bozorgian, A. Azimi, *Eurasian Chemical Communications*, 2020, 2(4): 536
- [35]. A. Bozorgian, M. Ghazinezhad, *J. Biochem. Tech*, 2018, 2: 149

- [36]. A. Bozorgian, *International Journal of New Chemistry*, 2021, Articles in Press
- [37]. A. Bozorgian, *Polymer*, 2012, 2: 3
- [38]. A. Bozorgian, S. Zarinabadi, A. Samimi, *Journal of Chemical Reviews*, 2020, 2(2): 122
- [39]. E. Opoku, *Journal of Chemical Review*, 2020, 2(4): 211
- [40]. A. Bozorgian, *Chemical Review and Letters*, 2020, 3(2): 79
- [41]. A. Pourabadeh, B. Nasrollahzadeh, R. Razavi, A. Bozorgian, M. Najafi, *Journal of Structural Chemistry*, 2018, 59(6): 1484
- [42]. A. Bozorgian, *Advanced Journal of Chemistry-Section B*, 2020, 2(3): 91
- [43]. K. Kavousi, S. Zarinabadi, A. Bozorgian, *Progress in Chemical and Biochemical Research*, 2020, 7
- [44]. A. Bozorgian, *Chemical Review and Letters*, 2020, 3(3): 94
- [45]. A. Bozorgian, *International Journal of Advanced Studies in Humanities and Social Science*, 2020, 9(3): 229
- [46]. A. Bozorgian, *Int. J. Adv. Stu. Hum. Soc. Sci.*, 2020, 9(3): 205
- [47]. A. Bozorgian, *Advanced Journal of Chemistry, Section B: Natural Products and Medical Chemistry*, 2021, 3(1): 54
- [48]. M. Esmaeili Bidhendi, Z. Asadi, A. Bozorgian, A. Shahhoseini, M.A. Gabris, S. Shahabuddin, R. Khanam, R. Saidur, *Environmental Progress & Sustainable Energy*, 2020, 39(1): 13306
- [49]. A. Bozorgian, *International Journal of New Chemistry*, 2021, Articles in Press
- [50]. M. Bagherisadr, A. Bozorgian, *Int. J. Adv. Stu. Hum. Soc. Sci.*, 2020, 9(4): 252
- [51]. A. Bozorgian, *Int. J. Adv. Stu. Hum. Soc. Sci.*, 2020, 9(4): 241
- [52]. M. Bagheri Sadr, A. Bozorgian, *Journal of Chemical Reviews*, 2021, 3(1): 66
- [53]. A. Bozorgian, *Journal of Chemical Reviews*, 2021, 3(1): 50
- [54]. M.J. Choobineh, M. Abdollahbeigi, B. Nasrollahzadeh, *Journal of Fundamental Applied Science*, 2016, 8(2S): 1150-1159
- [55]. M. Abdollahbeigi, *Journal of Chemical Reviews*, 2020, 2(4): 303-319
- [56]. M. Abdollahbeigi, M. Asgari, *Journal of Chemical Reviews*, 2020, 2(4): 257-272

How to Cite This Manuscript: Martin Zbuzant*, Investigation of the Complex of Cream Instruments in the Steel and Oil Industry. *Journal of Engineering in Industrial Research, (J. Eng. Indu. Res.)*, 2021, 1(1), 75-81. DOI: 10.22034/jeires.2020.262808.1009