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Treating the galvanization wastewater by complex process

Tong Zhen-Gong
School of Civil Engineering of East China Jiaotong University, Nanchang 330013, (CHINA)
E-mail : zzggtt@126.com

ABSTRACT

Treating the Galvanization wastewater by Complex process which includes chlorine dioxide coordination oxidant broken cyanogens process, iron filings internal electrolysis degraded the chromic wastewater and alkalinity precipitation method processed comprehensive wastewater. The water quality of the treated wastewater reached the request of the ⟨⟨Integrated wastewater discharge standard⟩⟩ (GB8978-1996). The paper described this engineering from following aspects including water quality and water quantity, treatment processes, flow explain, main buildings, investment and operation cost. The paper has certain guides for the same type wastewater treatment.

KEYWORDS

Chlorine dioxide oxidation;
Iron filings internal electrolysis degradation;
Alkalinity precipitation method;
Galvanization comprehensive wastewater.

PREFACE

Galvanization wastewater is one of industrial sewage which has broad source and severe pollution. It pollutes environment in two ways: one is the discharge of Galvanization wastewater is small quantity and high density, the other is the discharge of Galvanization wastewater is lower density. Compared with other industry, electroplating industry is less in discharge. But because electroplating plants distribute scatter and widespread, its pollution area is larger. Major pollutants of Galvanization wastewater are cyanide, chromium, acid, alkali and alkali salt, heavy metal and so on.

WASTEWATER QUALITY FEATURES

One company is a large professional manufactures of hardware. Plating types are chrome –plating and copper-plating. Pollutants of wastewater are Cu2+, Cr6+, Zn2+, CN-, and many kinds of toxic and harmful substance such as waste acids and waste alkalis. The water quality of the treated wastewater is demanded reached the request of the ⟨⟨Integrated wastewater discharge standard⟩⟩ (GB8978-1996. Raw and discharge water quality is presented by TABLE 1.

TABLE 1 : Raw and discharge water quality

Water quality	CN^- (mg/L)	Cr^{6+} (mg/L)	Cu^{6+} (mg/L)	Zn^{2+} (mg/L)	PH
Inflow	10~80	30~100	30~100	30~100	2
Effluent	≤ 0.3	≤ 0.5	≤ 0.5	≤ 2	6~9

For now, the factory wastewater discharge flow is about Q=400m^3/d, it is presented by TABLE 2. It predicts that the wastewater discharge flow is about Q=420m^3/d considering some leaking. Considering the development of this factory, the process design flow is Q=450m^3/d.

TABLE 2 : Wastewater discharge flow

Name	Cyanide-containing wastewater	Chromium-containing wastewater	Integrated wastewater	Total water
Produce wastewater	$100m^3/d$	$65m^3/d$	$235m^3/d$	$450m^3/d$

WASTEWATER TREATMENT PROCESS AND THE DESCRIPTION OF THE PROCESS

The selection of process flow

We can know from TABLE 1 that the wastewater mainly contain Cu^{2+}, Cr^{6+}, Zn^{2+}, CN^-. CN^- and Cr^{6+} are the first level pollutants so they should be collected and treated alone in a workshop. Therefore, the wastewater of this factory has to be collected by dividing into thirds: cyanide-containing wastewater, chromium-containing wastewater, integrated wastewater. Cyanide-containing wastewater mainly contains CN^-, chromium -containing wastewater mainly contains Cr^{6+}, integrated wastewater mainly contains heavy metal ions such as Cu^{2+}, Zn^{2+}.

(a) The selection of treatment for cyanide-containing wastewater

The cyanide-containing wastewater should be designed a individual treatment system and not treat with other Galvanization wastewater. Especially if the iron ion mix into the wastewater, it would became very difficult to treat this wastewater. There are many ways to treat the cyanide-containing wastewater such as alkaline chlorination process, electrolysis oxidation, activated carbon adsorption, ion exchange method, UVozone, ferrous sulfate and so on. Chlorine dioxide coordination oxidant broken cyanogens process is advanced and also has the applicable scope to be broad. It is simple, processing effect is good, less cost and without secondary pollution. This project will use Chlorine dioxide coordination oxidant broken cyanogens process.

(b) The selection of treatment for chromium-containing wastewater

There are two basic lines to treat wastewater containing Cr^{6+} as follows: one is to reduce Cr^{6+} into low toxic Cr^{3+}, and then using chemical precipitation to remove it including chemical reduction, electro reduce coagulation. The other line is resources recovery, such as ion exchange, activated carbon adsorption, reverse osmosis and so on.

Chemical reduce precipitation is widely applied because its simple equipment, low investment, good processing effect, small occupation area, convenient operation and management and good adaptability to the change of water qualities. Iron filings (iron powder) internal electrolysis belonging to chemical reduction has simple process, low price, extensive source, can fulfill requirements one time and also has some desalination and BOD removal. It has a very great development prospects. So we choose this method to remove Cr^{6+} in this design.

(c) The selection of treatment for integrated wastewater

The cyanide-containing wastewater and chromium-containing wastewater get into adjusting tank with a uniform inlet after treatment and then mix with wastewater containing copper, zinc, acid and alkali. Meanwhile, It 9~10 produces $Cr(OH)_3$, $Zn(OH)_2$, $Cu(OH)_2$ and some precipitation by adjusting PH value of wastewater to 9~10. In order to accelerate the precipitation rate, we can add PAC coagulant and PAM flocculant into wastewater to make larger alum. Then it can remove the heavy metal from the wastewater by precipitation and filtration. The supernatant after clarify by setting tank flows into filter, through pump, to have a filtration. Then PH adjusting tank adjusts PH value to neutral. After this, we can discharge the water or make use of it after some treatment. The sluge of setting tank have a concentration by thickening tank. It is transported to the outside after dehydration.

(d) Complex wastewater treatment process

We integrate these three treatments, the whole wastewater treatment process flow as shown in Figure 1.

Description of the process flow

Producing department discharge the three kinds of wastewater separately and treat them individually. In order to reduce errors in which some people result, the

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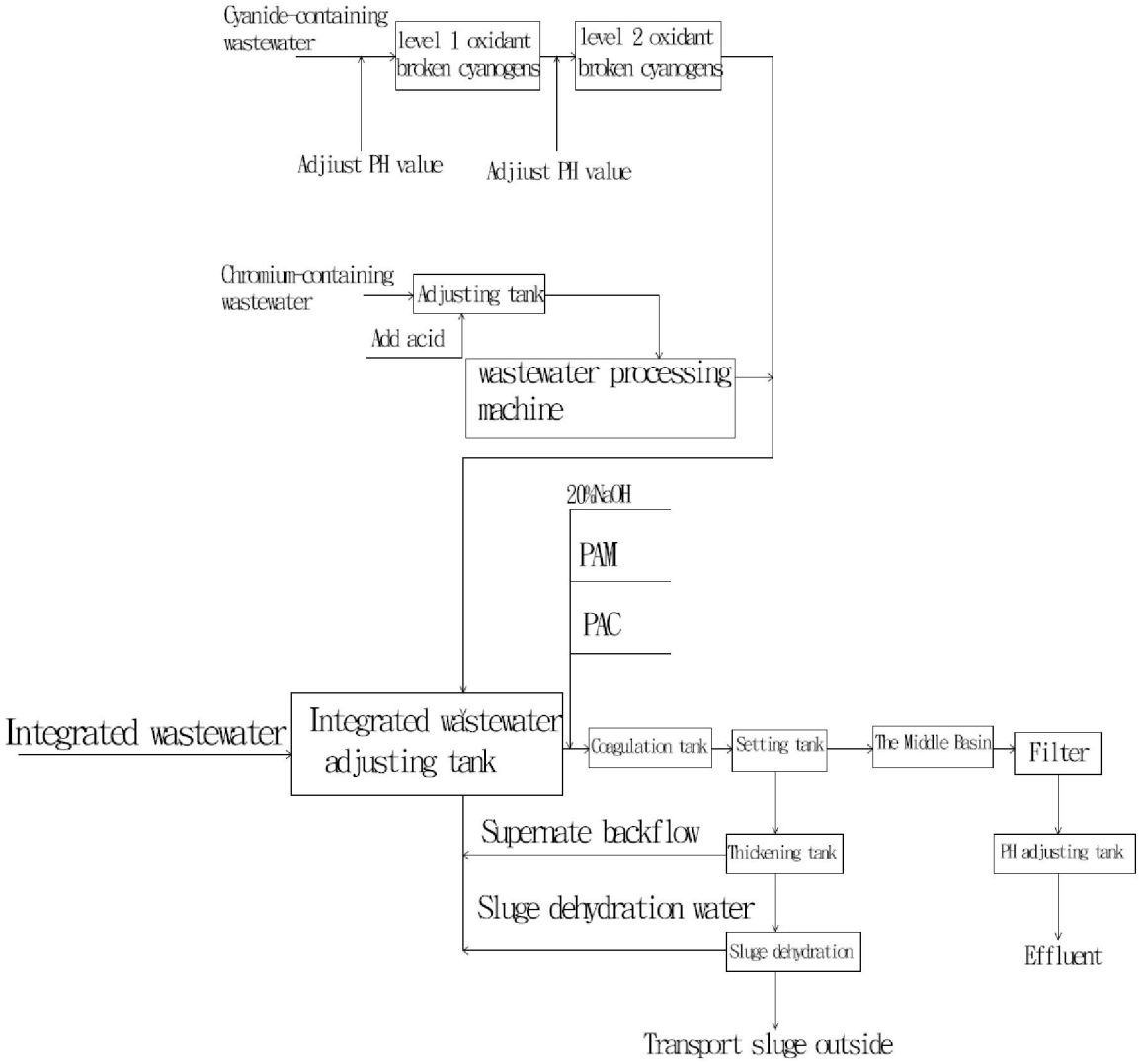
equipment has a automatedoperation, and we use PH meter and ORP meter to have a automated monitor; We install a liquidometer in every wastewater adjusting tank to automated monitor the operation of lift pump. Installing a liquidometer in the body of water to control the filter pump open/close; The dosing pump open/close is controlled by PH meter and ORP meter. When the PH value or ORP value of the wastewater reaches the setting value of open/close, adding reagent would start or stop. Every equipment operation also has a manual control, and it can be operated individually rather than work with other equipments.



Figl Complex wastewater treatment process flow diagram

(a) Cyanide-containing wastewater

Cyanide-containing wastewater flows into adjusting tank of cyanide-containing wastewater from workshop, and then flows into level 1 broken cyanogens tank by lift pump. Adjusting its PH value to 8.5~11.5. The wastewater under alkali condition, cyanide is oxidated by chlorine dioxide into nontoxic substance. After the wastewater through level 1 broken cyanogens tank, it flows into level 2 broken cyanogens tank by itself and its PH value is adjusted to 7.5~8.5. NaCNO produced by level 1 broken cyanogens tank converts into N_2 and CO^2 by chlorine dioxide. Wastewater after level 2 broken cyanogens merges into integrated wastewater adjusting tank to neutralize the integrated wastewater. Then they are treated together.

(b) Chromium-containing wastewater

Chromium-containing wastewater flows into chromium-containing wastewater adjusting tank by itself, and

using dilute acid to adjust its PH value to a certain value, then it flows into wastewater processing machine by pump. The wastewater flows from top to bottom in wastewater processing machine and reacts with scrap iron. The wastewater flows into integrated wastewater adjusting tank after treatment.

(c) Integrated wastewater

Integrated wastewater, cyanide-containing wastewater and chromium-containing wastewater flow into wastewater adjusting tank together. Adding reagent in the wastewater before the pump and they flow into the coagulating basin after a fast and uniform mixture. There is a PH meter to control the addition of reagent automatically, the PH value is generally from 8 to 10, then the wastewater flows into sedimentation basin. The supernatant after a clarification flows into the pond for storing water and then get into filtrator by pump to have a filtration. After this, the wastewater flows into PH adjusting tank to adjust the PH value. At last, the wastewater flows out from effluent weir. The sludge of sedimentation basin flows into sludge concentration tank through pipeline, the supernatant of concentration tank returns to the integrated wastewater adjusting tank and the sludge is forced into filter press to have a pressing dehydration by pump. The removal water returns to the integrated wastewater adjusting tank and the sludge cakes are transported outward. The water of PH adjusting tank is used to do a backwash for filtrator and wastewater processing machine, and it can save water by doing this.

(d) The selection of agentia

We choose caustic soda as precipitant whose concentration is 20%; And choosing vitriol whose concentration is 10% as acid; The flocculant is PAC, and the coagulant aids is PAM.

THE KEY CONSTRUCTION AND PROCESS EQUIPMENT

The key construction

(a) Adjusting tank

The adjusting tank is mainly used to adjust water quantity and homogenize water quality. Water quality of this design is stable and its change is not serious, so it is only used to adjust water quantity. This adjusting tank is on-line that all the water through the tank.. The integrated wastewater adjusting tank is made up of reinforced concrete. Its size is 6500mm × 5800mm × 2300mm.

(b) Sedimentation basin

The oblique-flow precipitating tank precipitates with high efficiency, has a short HRT and occupy small area, so we use it in this design. The sedimentation basin is made up of reinforced concrete. Its size is 2400mm × 2400mm × 4450mm.

(c) Concentration tank

The sludge concentration tank is mainly used for concentrating the space of sludge. This design we choose intermittent type gravity thicken tank to concentrate the sludge in consideration of the sludge's source and character, the whole process and final treatment. It is also made up of reinforced concrete. Its size is Φ1700mm × 4600mm.

The main process equipment

(a) Filter

Sand filtration tanks is a kind of economy, practical filter. This design we choose upflow filter to filtrate the wastewater, which has been precipitated, to have a further remove of suspended matter which hasn't been precipitated. Its size is Φ860mm × 1500mm.

(b) The equipment of sludge dewatering

The function of sludge dewatering is removing the capillary water and surface attached water of the sludge, thereby reducing volume and quality. Belt press filter can achieve continuous running, easy to operate, less accessory equipment, easy to manufacture, therefore the cost of investment, labor force, energy consumption, maintenance are low. This design we choose DY-500 belt press filter.

(c) Wastewater processing machine for removing chromium

This technique mainly chooses industrial waste iron filings by activated as material and uses integrated effect of electro chemical reaction, chemical reaction and physical process, including catalysis, oxidation, deoxidation, metathesis, flocculation, adsorption, coprecipitation, which are caused by microbattery effect to remove the heavy metal ion and other harm ions,

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so we can achieve the aim of purifying wastewater, discharging wastewater or resuing wastewater. According the flow of chromium-containing wastewater Q=3.03.0m^3/h, we choose ECF-A-III(a) wastewater processing machine.

OPERATION EFFECT

This project operates from July 2006. Monitoring the operation effect non scheduled, and the effect is shown in TABLE 3

TABLE 3 : The project operation effect

Treatment	Chlorine dioxide coordination oxidant remove cyanogens (mg/L)	Iron filings internal electrolysis degraded the chromic (mg/L)	Precipitation method processed comprehensive wastewater effulent (mg/L)	
Index	CN-	Cr6+	Cu6+	Zn2+
Number	0.28	0.42	0.4	1.5

WASTEWATER PROCESSING COSTS

The cost of sewage treatment plant usually includes salary and welfare fund expense, electricity, agentia cost, depreciation cost, examine and repair cost, administrative expenses and the charge for comprehensive utilization of wastewater. Operating practice shows the operation cost is 2.09 Yuan every ton wastewater.

CONCLUSION

According to the wastewater quality features, we treat the wastewater whose discharge flow is 450m^3/d under base on the principles which are removing pollutant and classifying flow, comprehensive treatment after preliminary treatment. We determine use chlorine dioxide coordination oxidant broken cyanogens process to treat the cyanide-containing wastewater, iron filings internal electrolysis treat chromium-containing wastewater, alkalinity precipitation method processed comprehensive wastewater. The water quality of the treated wastewater reached the request of the ⟨⟨Integrated wastewater discharge standard⟩⟩ (GB8978-1996). The total investment is 700,000, wastewater unit cost is 2.09 Yuan.

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