Potential Analysis of Energy Saving and Emission Reduction for Washing Industry

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Keywords: washing industry; energy saving and emission reduction; energy consumption; emissions; potential analysis

Abstract. With the development of Chinese washing and industry, the problem of large amount of energy consumption and exceed the discharge standard of sewage cannot be ignored. The development of washing industry is not mature. It leads to energy waste and environmental destruction. Under the macro environment of advocating energy saving and emission reduction, the washing and dyeing industry cannot keep out of the affair. By calculating energy consumption and emissions of washing and dyeing industry every year, it can be see that there is great potential for energy saving and emission reduction. Compared with the washing industry of developed countries, there is still a large gap. This requires while washing industry is vigorously developed, the energy consumption and emissions must be control, and supervision must be strengthened. The consciousness of energy saving and emission reduction must integrate into all aspects of company production and management.

Introduction

Along with our country economy development and the improvement of people's living standards, the textile and clothing industry grows rapidly. Social service like washing expands in large scale according to the increasing demand and the quality of service. What cannot be ignored is the higher energy consumption and emission of pollutants.

The development of textile and clothing industry

Along with the prosperity of the textile industry, the washing industry blossom in these years. The improvement of people's living standards makes them turn to the professional dyeing. At the same time, the required quantity and quality keeps increasing. This prompts the fast development of laundry and dyeing industry. The Laundry market can be divided into three levels: The first is community service. It mainly refers to the street laundry that direct service to the people. The second is functional washing like the washing in hotels, railway system, hospitals, civil aviation and logistics in military. The third is small batch dyeing, color alteration, sand washing and darning of textile and the production of chemical products.

Taking washing industry in Nanjing for an example, Nanjing has more than 1000 laundries for ordinary customers, among them there are about 50 large laundries, 300 medium laundries and 1000 small laundries. Their annual output value 600 million yuan and their number of employees is around 25000. From the aspect of ownership, there are a dozen of state-owned enterprises and the rest are private individual enterprises. In public washing of textiles, there are about 60 factories, which offer washing service for hotels and restaurants, including 9 state-owned enterprises, 26 private enterprises, 25 individual enterprises, 2 joint ventures. The rest are individual washing workshop. According to the statistics from Nanjing Washing and Dyeing Industry Association (NWDIA), the growth rate of the chain enterprise is approximately 10 percent.

By evaluating there are approximately 250 million washing an laundries and factories, which have 1.250 million employees and their annual income value exceeds 60 billion yuan. For the five-year period until 2016, the average annual growth rare in laundry and dyeing industry will be more than 18 percent. And by 2015, the annual income can exceed 100 billion yuan. So, it is an inevitable trend to increase the need to professional dyeing and enlargement of the scale.

The existing problems of washing and dyeing industry

In these years, washing industry achieved explosive growth within the intense free competition in the market. However, small laundry accounts for 99% of the market. It still lags far behind some advanced countries. Many problems in the industry need to be concerned. The related policies, national and industry standards need to be made; Environmental monitoring mechanism is not suitable for the washing industry; Uniform standard is lack for open condition, environmental requirement, service specifications, quality of service of the laundry. And the lack of standardized management, poor equipment, few professional training for the employees all contributes to the backward situation. The washing industry consume large amount of water and energy, while the measures to saving water and energy are scarce, and the wastewater usually will drainage without treatment. Because of the lack of policies and long-term financial support, energy saving and emission reduction measures of washing industry had not received enough attention. Many leaders we contacted feel depressed to the situation. These are directly or indirectly caused enormous waste of resources and over-discharged pollutants.Europe and the United States currently has a mature technology and reliable washing wastewater reuse equipment,reuse rate have reached 40-80%[1-2] Under the circumstances that national advocacy of energy saving and emission reduction, the government should strengthen the importance of energy saving and emission reduction.

Potential analysis of energy saving and emission reduction for washing industry

Laundry scale standard. According to the daily amount of washing and plant area of laundries usually can be divided into large, medium, small, standard type four classes.

Large laundries: the laundries have an area more than 200 square meters, and the daily amount of washing is around 4300kg.

Medium laundries: the laundries have an area more than 150 square meters, and the daily amount of washing is around 2600kg.

Small laundries: the laundries have an area more than 100 square meters, and the daily amount of washing is around 1100kg.

Standard laundries: the laundries have an area around 50-80 square meters, and the daily amount of washing is around 220kg.

According to work 10 hours a day and different the amount of washing, the equipment status lists in Table1 and Table 2.

Table1: Laundry Washing Scale and Equipment

Type	Washing machine/ Dehydrator		Dry cleaning machine		Dryer		Mangle	
	Model	Amount	Model	Amount	Model	Amount	Model	Amount
Large	100kg	3	15kg	5	100kg	2	30 Three drum	2
	50kg	1						
	30kg	1	10kg	5	50kg	1		
Medium	100kg	2	15kg	3	100kg	1	28	1

	50kg	1	10kg	3	50kg	1	Double drum	
Small	50kg	2	10kg	3	30kg	2	28 Single drum	1
Standard	15kg	1	10kg	1	50kg	1	28 Single drum	1

Table 2: Washing Equipment Parameters

Type	Water Consumption /Time (kg)	Power Consumption / Time (kW)	Air Consumption / Time (kg)
15kg Washing machine	600	1.0	13
30kg Dehydrator	1000	1.5	20
50kg Dehydrator	1200	2.1	30
100kg Dehydrator	1800	3.2	50
10kg Dry cleaning machine	/	2	10
15kg Dry cleaning machine	/	2.2	15
30kg Dryer	/	0.75	50
50kg Dryer	/	1.1	75
100kg Dryer	/	4.4	130
2800 Single drum Mangle	/	0.75	135
2800 Double drum Mangle	/	1.5	250
3000 Three drum Mangle	/	2.2	365

Energy and water consumption of washing and dyeing industry. According to the investigation and the analysis of its washing industry scale, taking the national second-tier city as an example, there should be 10 large laundries and factories, 50 medium laundries and factories, 200 small laundries, 3000 standard laundries at least. According to the above status of equipment equipped, we can estimate the energy and water consumption of a national second-tier city.

Water consumption. Considering the dry cleaning machine use only cooling water, and it can be recycled, water consumption is small, so we calculate the water consumption of washing machine and dehydrator, providing that each machine work 11 times every day, every time 45 minutes.

So we can do a calculation about the water consumption of different types of machines in laundries and factories:

Standard laundries: 0.6t/machine×1machine×11times×360d=2376t

Small laundries: 1.2t/machine×2machine×11times×360d=9504t

Medium laundries: [1.2t/machine×1machine+1.8t/machine×2machine]×11times×360d=19008t

Large laundries: [1.8t/machine×3machine+1.2t/machine+1t/machine]×11times×360d=30096t

According to the calculation above, the annual water consumption of national second-tier city is [2376×3000+9504×200+19008×50+30096×10]=10280160t.

Energy consumption-Power consumption. The power consumption of the laundry comes mainly from the dehydrator, dry cleaning machine, dryer, mangle. We can provide that each washing machine runs 10 times; dry cleaning machine runs 10 times; dryer runs 4 times, each time 0.75 hour; mangle runs 6 hours every day.

So we can do a calculation about the power consumption of different types of machines in laundries and factories according to their parameters.

Standard laundries: (1.0×11times+2×10times+1.1×4times)×0.75h+0.75×6h=31.05KWh

Small laundries:

(2.1×2items×11times+2×3items×10times+0.75×2items×4times)×0.75h +0.75×6h=88.65KWh

Medium laundries:

[(3.2×2items+2.1)×11times+(2+2.2)×3items×10times+(1.1+4.4)×4times] ×0.75h+1.5×6h=190.125KWh

Large laundries:

[(3.2×3items+2.1+1.5)×11times+(2+2.2)×5items×10times +(1.1+4.4×2items)×4times]×0.75h+2.2×2items×6h=322.5KWh

According to the calculation above, the annual power consumption of national second-tier city is 44500050KWh, which equals to about 17978t standard coal(1KWh power=0.404kg standard coal).

Vapor consumption. The vapor consumption of the laundry comes mainly from the dehydrator, dry cleaning machine, dryer, mangle.

So we can do a calculation about the vapor consumption of different types of machines in laundries and factories according to their parameters.

Standard laundries:

(13×11times+10×10times+75×4times)×0.75h+135×6h=1217.25kg

Small laundries:

(30×2items×11times+10×3items×10times+50×2items×4times)×0.75h+135×6h=1830kg

Medium laundries:

[(50×2items+30)×11times+(10+15)×3items×10times+(75+130)×4times]×0.75h+250×6h=3750kg

Large laundries:

[(50×3items+20+30)×11times+(10+15)×5items×10times+(130×2items+75)×4times]×0.75h+365 ×2items×6h=7972.5kg

According to the calculation above, the annual vapor consumption of national second-tier city is 1542591t, which equals to about 257100t standard coal (6t vapor=1t standard coal).

To sum up, the annual energy consumption of washing and dyeing industry is about 0.276 million t in a national second-tier city.

The emissions of pollutants of washing wastewater - The concentration of washing wastewater pollutants. The washing wastewater is referred to the wastewater from water washing machine. Its pollutants contains surface-active agent, caustic soda liquid, fungicide, preservative, softening agent, fat, animal and vegetable oil, protein and other dissolved organic matter. There are also some soil, flocks and other soluble impurities. Table 3 lists several main pollutants' content of washing wastewater.

Table 3: Summary of the washing wastewater pollutants concentration and average concentration

Washing wastewater	Index						
	COD_{Cr} mg/L	BOD_5 mg/L	LAS mg/L	SS mg/L	TP mg/L	pH	NH_3-N mg/L
Liuzhou passenger traffic section [3]	50-350	-	30-50	50-100	-	8-10	-
Hangzhou passenger traffic section [3]	137.09-540	-	9.05-85.96	26-66.5	0.1-0.93	7.85-10.55	-
Chengdu passenger traffic section [3]	196-489.24	-	17.27-51.56	-	2.95-13.2	6.9-9.82	-
Tianjin passenger traffic section [3]	37.2-520	13.09-177	1.99-78.9	15-496	0.3-7.9	8.5-12.51	-
Shenyang passenger traffic section [3]	287	-	3.7	-	-	8.3	-
Beijing passenger traffic section [6]	100-200	50-100	3-8	-	-	8-10	10-14
Zhuzhou laundry industry park [4]	668	349	3.9	445	-	4-7	3.5-29
Textile laundry shop [5]	845	250	-	215	-	7.46	28.6
Mean concentration	400	170	60	-	7	-	15

The washing wastewater has the characteristic of large, stable drainage volume, and the pollutant concentration is low. If appropriate process is taken, the water can be reused in washing the car, afforestation, sight design as well as flushing the toilet. It is a one of the effective ways to reduce water pollution, improve the eco-environment, and relieve the pressure of water available in the city.

The main pollutant emissions in the washing wastewater. According to the current research situation, the washing wastewater usually drained without treatment. In other words, the amount of water consumption is equal to the wastewater, so we can determine the pollutant emissions according to the amount of water consumption and mean pollutant. On the basis of water consumption in a national second-tier city, we can calculate the amount of pollutants emission. The CODCr is about 4112t, LAS is about617t, BOD5 is about 1748t, TP is about 72t and the NH3-N is about 154t.

Potential analysis of energy saving and emission reduction for Chinese washing industry. The washing and dyeing industry in China is energy and water intensive industry. Their Potential of energy saving and emission reduction cannot be ignored. Although In recent years China's washing industry has a certain improvement and development in energy saving and emission reduction technology and equipment, the production and technology only applied in the several enterprises but not all. Most of the washing and dyeing factories, especially the small and standard laundries, downplay the significance of the energy saving and emission reduction. If the government offers them some financial support and perfects relative policies, the abatement effect can achieve 20 percent. So the huge effect can be initially calculated and we also take a national second-tier city for example. 822t CODCr, 123t LAS, 359t BOD_5, 13t TP, 30t NH_3-N would be decreased in a year.

Conclusion

If energy saving and emission reductio effect can achieve 20 percent in a national second-tier city washing industry, in a year, more than fifty thousand tons of standard coal energy consumption would

be saved and more than two million tons of wastewater discharge would be reduced.at the same time,822t CODCr, 123t LAS, 359t BOD_5, 13t TP, 30t NH_3-N would be decreased accordingly. There are considerable potential of energy saving and emission reduction for Chinese washing and dyeing industry. The energy saving and emission reduction can be gradually expand with a series of measures like controlling the energy consumption and emission, strengthening supervision, improving the process technology, attracting extensive attention to the energy saving and emission reduction and make it integrated into all aspects of the enterprise production management.

Acknowledgements

This work was financially supported by Open Research Fund Program of Beijing Climate Change Response Research and Education Center（Beijing University of Civil Engineering and Architecture）.

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