POLITECNICO
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Using systemic vision to study and improve shared bikes in Nanjing

Thesis For Master of Science Degree in Systemic Design

Department of Architecure & Design

Tutor: Profa. COMINO ELENA

Candiate: LIU BINYAO, XIA YUANCHANG

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Abstract:

In recent years, Shared bikes have become very popular in China. This Shared bike has no fixed parking areas. It is famous for its environmental protection and convenience for users. The founders of Shared bikes hope to reduce resource waste, reduce pollution and provide convenience for people by this sharing mode. However, the waste and emission of Shared bikes in the production process, the unreasonable allocation of resources in operation, the encroachment of public space and other problems, as well as the damage and abandonment of bikes have become new social problems. This paper aims to solve the above problems, among which reducing emissions, increasing the utilization of resources and improving user experience are the main research directions of this thesis.

Keywords:

Systemic; Shared bikes; Product flow; Operation flow; Proposal design

Contents

I The purpose and the significance of study

Since it was founded in China in 2014, the shared bicycle is very popular among the public. It is one of the successful products of the "shared economy" which has developed rapidly under the rapid development of Internet technology. At the same time, with the concept of "low-carbon lifestyle" being deeply rooted among the people, the development of shared bicycles has been developing rapidly. There are more and more APP about shared bicycles. However, a series of problems are followed: the waste of resources caused by excessive delivery and the occupation of public space; malicious destruction; the disclosure of private information after the registration of APP, etc. On the basis of a large amount of collecting and consulting information, this thesis analyzes and summarizes the existing problems in the production, operation of the shared bicycle and the problem in handling of the old damaged bike, and puts forward the corresponding solutions and measures with flowcharts.

The purpose of the study:

1. The purpose of the study is to give some solutions to solve the problems existing in the current production - operation system of shared bicycles, such as resource waste, pollution and space occupancy.
2. Saving resources and convenient for people's life.
3. Guarantee the legitimate rights and interests of consumers, including personal information security interests and personal assets rights and interests.

The problem to be solved:

1. During the productive process:

a). Reduce and recycle the waste.
b). Reduce the environmental pollution.

2. During the period of operation:

a). User registration app starts using shared bicycles, which results in personal information security. How can users protect their personal information when APP is registered?

b). A deposit must be paid if a bicycle is used. Is the operator misappropriating the user deposit? Is the collection and management of deposits conformed to the legal? For users, whether the deposit can be returned on time, and whether the rights and interests of users can be guaranteed.

c). Public space also has legal rights and interests (public resources privilege). Whether the profit - making operator should submit the cost of public space occupation and management to the city, obey the arrangement of the city manager, conform to the planning of the city management. Thus it relieves the pressure of urban public space. At the same time, the distribution of the number of bikes is not reasonable: the high frequency area often has the users can not rent a bike, and some areas with low frequency are idled. After investigation, we should take corresponding measures to improve this problem. The user is not standardized to park the bike, which is inconvenient for the use again.

d). The charge problem that users care about in the process. According to the information on internet, many users are not satisfied with the existing billing system: the current fee scale is sectionalized: 1 yuan per 30 minutes per bike, no ceiling, and the second times unlocking the bike information on internet, many users are not satisfied with the existing billing system: the current fee scale is sectionalized: 1 yuan per 30 minutes per bike, no ceiling, and the second times unlocking the bike recharged. This is not very cost-efficient for people who ride many times in a short time. How to improve the charging system to make it more reasonable?

e) After unlocking the bike, it was found that the bike was damaged and the customer service could not handle the repairs in time. This will impact on the user experience.

3. During the end of use:

a). How to recover and reuse the damaged bikes and non-human wastage?
b). How can human damage be supervised and paid?

4. During the re launch.

The methodology:

Through the research and analysis of the problems, combined with the current situation, the following flowcharts are given.

1. The flow of production. (current/proposal)
2. The flow of operation. (current/proposal)
3. The solution to reuse disposal of damaged bikes and non-human wastage. These bikes act as materials for new products in this flow.
4. After repairing, a part of the bikes were reinvested into the market, and their mission was continued. The new products were also put into the market to generate economic benefits.

These flows, in a sense, reflect the current problem, and the new flows are redesigned through integration and put forward solutions. These flows will serve as a description of the current situation and theoretical basis for improvement.
On the other hand, the waste and loss of each production phase will be reused, reducing the loss of resources, and developing new related products to increase the profit and user experience. (through these new products to achieve additional benefits, but also to serve the public, to achieve "double-wins").

Shared bicycles also benefits the current "low-carbon travel" requirements. Though there are some problems at present, there are feasible ways to improve it and its prospects are very optimistic.

II The introduction of shared bike

2.1 Brief introduction of shared bike

The shared bike originated in Holland, Amsterdam, in 1965. At that time, the bike was not made to order and there was no designated bike parking areas. Users could ride it at any time. This project is a public welfare project and is completely free. Subsequently, Denmark, France, Hungary, the three countries on the appearance of bicycles, reformed operating mode. In 1995, a custom-built bike was launched in Copenhagen, Denmark with docking areas. The user needs to a coin to open the lock, and after taking the bicycle and parking in the specified position, the coin can be removed. Three years later, there was a third generation shared bike in Ryan, France. In addition to custom-built bicycles and parking in docking area, users need to register smart cards through personal information. And the first 30 minutes free trial, more than 30 minutes users need to charge a small fee. In 2005, Hungary began to operate the fourth generation of shared bike in Budapest. The custom-built bicycles had GPS, intelligent locks and other electronic equipment. It was dockless. Users installed App on the cell phone and they can search nearby bikes. Users pay a little for using.

The bicycle sharing company OFO was founded in Beijing, China, 2014 and this marks the start of shared bikes in China. OFO uses the fourth generation of shared bike mode of operation: custom-built bicycles, built-in GPS and other electronic equipment, fixed parking spot. Users need to download and register APP with personal information, charging on time. This shared bike mode was initially tested in the campus, and after being praised, it began to be promoted outside school. In 2016, the shared bike became popular in China, and a large number of shared bike brands appeared， for instance, Mobike, OFO, Hellobike, YiMing, QuickRabbit, Youon, etc. As of 2017, shared bike covers over 30 cities in China and shares up to 13 bicycle brands. After the competition in 2016, now the mainstream brands of shared bike are: Mobike, OFO, Hellobike, and Youon. The shared bike has launched 20 million bikes in China, with 18,860,000 users. According to the relevant data in 2017, the market of shared bike will increase in 2018.

Shared bicycle is so popular that it can be seen from three aspects. From the perspective of traffic demand, shared bike plays a complementary role in public transport. Most cities in China are densely populated, especially in commercial centers. Traffic jams happen all the time during rush hours and it is inconvenience for commuters. Shared bike solves part of the traffic congestion, and choosing shared bike can effectively avoid traffic congestion. Because there are more chances to get a job in big cities, a large number of people are pouring into the cities. The living space is expanding outward. Some large residential areas are located on suburbs. These communities have a certain distance from the public transport sites. Walking to these transport stations is a bit far away, so shared bike becomes a reasonable and convenient transportation. From the point of view of operation, it is very convenient for shared bikes to use app to unlock, search and collect fees. With

mobile phone, you can use at any time and stop at any time. Shared bike in China is priced at a single rate of 0.5-1.0 yuan per minute on average.Each operator will also carry out promotional activities, which is attractive to users. From the perspective of the lifestyle of citizens, shared bike in addition to a kind of transportation, there are also entertainment and leisure, cycling fitness and other benefits. It is more convenient to park at any time than to buy a bicycle. At the same time, the concept of "low carbon and environmental protection" is deeply rooted in the hearts of the people, and the public also favors the shared bike as a convenient transportation.

With the popularity of shared bike, some problems are arising. From the operational perspective, operators put a large amount of bike in the market leading to a waste of resources. Because of the scattered and disordered bicycles caused by dockless parking, it is more difficult for operators to repair and recover the damaged bikes. For users, the deposit cannot be returned in time. The customer service is inefficient and problems cannot be solved in time, which seriously affects user experience.

The development of shared bike is not only a business mode but also a way of life. Its existence has already become a part of people's life, and it has produced a series of behaviors and influences. We study the shared bicycle not only to analyze the impact of its production, but also to find the problems from its operation and propose solutions. By improving these production and operation processes, we finally come up with a reasonable plan. This plan is designed to provide a reference for each shared bike operator, but also to improve the user experience. Shared bike as an important part of the "shared economy" has great potential. The significance of this article is to optimize each part of shared bike.

2.1.1 Brief introduction of OFO

OFO is a Beijing-based bicycle sharing company founded in 2014. It operates over 10 million yellow bicycles in 250 cities and 20 countries, as of 2017. The docklessofo system uses its smartphone app to unlock and locate nearby bicycles, charging an hourly rate for use. As of 2017, the company is valued at $3 billion and has over 62.7 million monthly active users.

The company was founded in 2014 by five members of the Peking University cycling club as a project that initially focused on bicycle tourism before deciding on bicycle sharing. It was named "ofo" due to the word's resemblance to a cyclist on a bicycle. ofo was launched in June 2015 in Beijing, gaining 20,000 users and 2,000 bicycles by October with investment funding from a Peking University alumnus. In 2016, ofo expanded to other cities in China, and had a fleet of 85,000 bicycles by the end of the year. The company raised $130 million in funding from tech firms Xiaomi and Didi Chuxing in September 2016, allowing it to expand outside China.[11] A Series D funding round in February 2017, led by Didi Chuxing and Russian investor Digital Sky Technologies, raised $450 million for ofo and valued the company at $1 billion.

OFO began expanding outside China in 2017, with launches in Singapore in February 2017; Cambridge, United Kingdom in April; Seattle, United States in August; and Sydney, Australia in October.

In April 2017, it was announced that the United Nations Development Programme has started a partnership to raise public awareness on climate changes. The partnership project, 1 KM Action, lead to another collaboration with the Clara Lionel Foundation, an organisation founded by Rihanna, which aims to provide bikes and scholarships to girls in Malawi.

The same month, ofo announced an undisclosed amount of funding from Ant Financial, an Alibaba affiliate.

In July 2017, ofo announced $700 million of additional funding in a round led by Alibaba, Hony Capital and Citic PE.

In February 2018, Texas A&M University partnered with ofo and rolled out a bike sharing platform on campus.

OFO raised an additional $866 million led by Alibaba in March 2018.

On May 1, 2018, ofo launched in Camden, New Jersey as part of a 9 month feasibility study with 200 bicycles. In June 2018, ofo launched in Atlanta, Georgia. (1)

Founder:

Dai Wei, the founder and CEO, a young entrepreneur, graduated from Guanghua School of Management,Peking University. In 2014, he founded ofo with 4 partners and put forward an idea which can solve the problem of "the last mile of trip" through sharing economy and intelligent hardware, and created the first company in China to operate campus bicycle business on a sharing platform.

Scale of company:
Since its launch in June 2015, OFO has offered 10 million shared bicycles to more than 200 million users in more than 250 cities of 20 countries, and has provided more than 4 billion times of travel service.

Development history:
2014 Foundation
2015.6，OFO sharing program was launched and acquired 2000 shared bicycles in Peking University.
2015.10，Pre-A round financing was completed.
2016.1，A round financing was completed.
2016.8，A+ round financing was completed.
2016.9，B round financing was completed.
2016.9.26，Get a strategic investment of Didi.
2016.10.10，Complete C round financing with $130 million
2016.11.17，Officially launched city services, launched OFO 3.0. Start strategic cooperation with 700bike.
2016.12.16，OFO entered Chengdu and Xiamen formally.
2016.12.23，OFO pioneered its overseas strategy and launched its trial operation in San Francisco and London.
2016.12.27，OFO confirmed the Singapore market.
2017.1.11，OFO covered 33 cities in China
2017.3.1，D round financing was completed.
2017.4.22，OFO got D+ round investment from Ant Financial
2017.8.1，OFO officially announced landing in Thailand，6000 shared bicycles were released in the first batch
2017.8.27，OFO announced its entry into Vienna. 2000 shared bicycles were released in the first batch
2017.9.5，OFO announced its entry into London
2018.3.28，OFO entered Japan
2018.3，OFO completed E2-1 round financing with $866 million

[1] https://en.wikipedia.org/wiki/Ofo_(company)
[2] https://baike.baidu.com/item/ofo%E5%B0%8F%E9%BB%84%E8%B-D%A6/20808277?fromtitle=OFO&fromid=20104243#10

2.1.2 Brief introduction of Mobike

Mobike , founded by Beijing Mobike Technology Co., Ltd., is a fully station-less bicycle-sharing system headquartered in Beijing, China. It is, by the number of bicycles, the world's largest shared (for hire) bicycle operator, and in December 2016, made Shanghai the world's largest bike-share city.

In June 2017, Mobike raised $600 million in Series E funding led by Tencent, bringing the firm's fund raising in 2017 alone to nearly US$1 billion. In the same month, the company was valued at US$3 billion.

In April 2018, Mobike was acquired by Chinese web company Meituan-Dianping for US$2.7 billion.

Currently Mobike operates in over 200 cities around the world. The Chinese cities include but are not limited to Beijing, Shanghai, Guangzhou, Shenzhen, Chengdu, Lanzhou, Ningbo, Xiamen, Foshan, Zhuhai, Changsha, Hefei, Shantou, Haikou, Deyang, Nanning, Guiyang, Xi'an, Wenzhou, Wuhan and many more. Operations in Singapore, the company's first overseas market, started on 21 March 2017. It has since expanded to serve 15 countries including China.

Mobike began to expand its operations overseas in 2017. In the summer of 2017, after having launched bikes in its 100th city Manchester in Great Britain, Mobike began operations in Florence and Milan in Italy. This was followed by London in September 2017, Sydney in November 2017 and the Gold Coast, Queensland in February 2018. Mobike Japan was launched on 22 June 2017, Fukuoka being its first recipient. Mobike officially launched in Malaysia on 6 September 2017, with the first bikes being rolled out in Setia Alam and Cyberjaya just a month later. On 20 September 2017, Mobike's first bike-sharing service in the United States started from Washington, D.C., United States, which became an important step for Mobike to expand their business to North America. On 9 November 2017 Mobike officially launched in Rotterdam, The Netherlands. The ceremony was attended by special guest Chantal Blaak (2017 world champion cycling women's road race).

In November 2017, Mobike removed all of its bicycles from Manchester. Although this led to rumours that the bikes were pulled out of the city due to vandalism, an official statement by the company said that the bikes would return to the city as part of a new phase of the program, with a new operation zone so as to concentrate the range that the bikes can be used in.

On 21 November 2017, Mobike launched its operations in Germany by deploying 700 bicycles in Berlin, making it the 200th city worldwide with Mobike's bicycle sharing operations.

On November 2017, Mobike launched its operations in Turin and Bergamo, its third and fourth city in the Italian market.

During early 2018, Mobike launched its operations in Santiago, Chile..

By the end of the 2017, Mobike cooperated with Japan's largest messaging app. April 2018, Mobike has planned to enter 20 Cities in Japan by this year.

In May 2018, Mobike launched its operations in Israel in several cities like Tel Aviv, Rehovot and Kiryat Bialik.(1)

Founder:
Hu Weiwei, the founder of Mobike was born in Dongyang, Zhejiang, graduated from Journalism Department of Zhejiang University City College in 2004. Before Mobike, she had a ten-year-experience in automobile technology media, which made her pay special attention to the changes bring by technology. She founded the technology media Geek car and served as CEO. Before that, she worked in Geek Park, Tencent, SAIC and Beijing News.

Scale:
Up to October 2017, Mobike has entered more than 180 cities in 9 countries and offers more than 7 million shared bicycles, with more than 200 million global users and more than 30 million cycling every day.

Development history:
2015.1.27 BeijingMobike Technology Co., Ltd. was established
2015.10 Completed A round financing
2016.4.21 Mobike intelligence (Wuxi) Co., Ltd. was established
2016.4.22 Mobike officially operated in Shanghai
2016.8 Completed B round financing
2016.9.1 Mobike officially operated in Beijing
2016.9.30 Completed C round financing with $100 million
2016.10.17 Mobike Lite was released officially
2016.10 Completed C+ round financing
2016.10.27 Mobike officially operated in Guangzhou
2016.11.15 Iterative release of Mobike Sports Edition
2017.1.4 Completed D round financing with $215 million
2017.1.23 Cooperate with Foxconn
2017.2.20 Ccompleted the new financing after D round, D round of financing accumulated over $300 million
2017.3.21 Mobike officially operated in Singapore
2017.6.13 Mobike officially operated in Britain, first stop: Manchester, Salford.
2017.6.16 Completed E round financing with $600 million
2017.7.25 Mobike officially operated in Italy, first station: Florence and Milan.
2017.8.23 Mobike officially operated in Japan, first station: Sapporo
2017.8.30 Mobike officially operated in Thailand, first station: Bangkok
2017.9.7 Mobike officially operated in Malaysia, first station: Sha Alan, capital of Selangor state
2017.9.21 Mobike officially operated in America, first station: Washington, D.C.
2017.10.18 Mobike officially operated in Korea, first station: Suwon

[1] https://en.wikipedia.org/wiki/Mobike
[2] https://baike.baidu.com/item/%E6%91%A9%E6%8B%9C%E5%8D%95%E8%BD%A6/19737256?fr=aladdin
[3] https://mobike.com/cn/timeline/

2.1.3 Brief introduction of Hellobike

Hellobike is a smart travel integrated company dedicated to providing users with light and free travel tools. Adhering to the mission of "promoting travel with science and technology", the company adheres to the service concept of "green, low carbon and shared travel", and provides users with convenient, green and economic sharing travel services in short, medium and long distances. The company strives to ease urban traffic pressure, reduce vehicle emissions, and provide a three-dimensional sustainable travel solution for smart cities.
Since its establishment, Hellobike has showed itself from the fierce competition of shared bicycle market through its rapid replication and expansion capability, the efficiency of technology-guided vehicle operation and maintenance and the excellent control of the overall operating cost.

Hellobike has acquired the investment of several famous investment institutions such as Ant Financial, Fosun, GGV, Chengwei Capital and so on. In October 2017, it combined with Jiangsu Yongan Low-carbon Technology Co., Ltd., and became an important strategic partner with Ant Financial, Shenzhen Capital Group, Youon Technology Co.,Ltd and so on.

At present, Hellobike has entered 220 cities such as Ningbo, Hangzhou, Xiamen, Wuhan, Nanjing, Changsha, and Qingdao. At the same time, it also enters 200 scenic spots to provide intelligent sharing service for users.[1]

Founder:
Yang Lei. In July 20, 2017, he was selected to the list of 2017 Forbes China's 30 elite list under 30 years old.[2]

Scale of company:
Hellobike quickly enters more than 180 cities and 160 scenic spots. About 5 million bicycles, nearly 100 million registered users, and 10 million times daily riding.[3]

Development history:
2016.9, Hellobike project was established
2016.10, Research of Hellobike 1.0 and its production.
2016.11, Hellobike announced the completion of the A round of financing
2016.12.6, Trial operations in Xiamen
2016.12.12, Hellobike Officially declared to be in Xiamen.
2016.12.26, Hellobike and Ping An Insurance Company of China made a strategic cooperation to creat claim guarantee plan
2017.1, Hellobike announced the completion of the A+ round of financing.
2017.3.11, Hellobike entered Wuhan

2017.3.13，Hellobike entered Nanchang
2017.4，Hellobike entered Tianjin
2017.7，Hellobike entered Harbin. Hellobike completed hundreds of millions of B+ round financing
2017.10，Hellobike combined with Yongan Low Carbon Technology Co., Ltd.
2017.12.27，Hellobike announced the completion of 1 billion yuan D2 round of financing.
2018.3.13，Hellobike announced deposit free in whole country.
2018.4，Hellobike completed the E1 round of financing.[4]

[1] https://baike.baidu.com/item/%E5%93%88%E7%BD%97%E5%8D%95%E8%BD%A6/20496948?fromtitle=Hellobike&fromid=20188385&fr=Aladdin
[2] https://baike.baidu.com/item/%E6%9D%A8%E7%A3%8A/22097856
[3] http://baijiahao.baidu.com/s?id=1595100312565583055&wfr=spider&for=pc
[4] http://www.hellobike.com/about.html

2.2 Brief introduction of shared bike in Nanjing

The investigation of sharing bike in Nanjing

Market statistics:

Option \ The Company	OFO	Mobike	Hellobike
The amount of bike put on the market (ten thousands units)	16	11.5	8
The cost of each bike (CNY¥)	350	1000	650-750
The proportion of the market (%)	49.2	35.4	15.4
Damage rate (%)	20%-40%	10%-20%	Less than 4%
Market saturation (%)	120%		

Charging System:

Price (CNY¥) / Time (h) \ The Company	OFO		Mobike		Hellobike
	Normal price	Recharge 100 and return 200	Mobike (The modle of the bike:27kg) (Gradually replace the old bike with Lite by the end of October 2017)	Lite (The modle of the bike: 18kg) (The thesis is talk about this type of bike.)	Every day for the first time has 15 minutes riding for free: It means after locking the bike in 10 minutes you can ride any Hellobike again in 15 minutes for free. (each user one time per day, from 6:00 to 23:00). After 23:00 all users ride the bike for free.
≤0.5	1.0	0.5	1.0	0.5	
0.5-1.0	1.0	0.5	2.0	1.0	
1.0-1.5	2.0	1.0	3.0	1.5	
1.5-2.0	2.0	1.0	4.0	2.0	
2.0-2.5	3.0	1.5	5.0	2.5	
2.5-3.0	3.0	1.5	6.0	3.0	

The Deposit:

The Company / Option	OFO	Mobike	Hellobike
The deposit (CNY¥)	99	299	199; If you have more than 650 credit score on Alipay (a third party credit institution), you can exempt the deposit.
The period of a returnable deposit	Return the deposit immediately	2-7 working days	Return the deposit immediately

[1] https://wenku.baidu.com/view/591dcf9977eeaeaad1f34693-daef5ef7bb0d127b.html
[2] https://baijiahao.baidu.com/s?id=1565218927154814&wfr=spider&for=pc
[3] http://www.bikehome.cc/news/20171027/566614_1.html
[4] http://baijiahao.baidu.com/s?id=1560828764340687&wfr=spider&for=pc
[5] http://www.sohu.com/a/131515153_427760
[6] https://www.zhihu.com/question/57699573
[7] https://www.zhihu.com/question/55934549/answer/299228168
[8] http://news.163.com/17/0518/10/CKNA3JSV000187VG.html
[9] https://news.mydrivers.com/1/563/563538.htm
[10] http://news.jstv.com/a/20171208/151271353229.shtml

III The current situation and proposal situation comparison

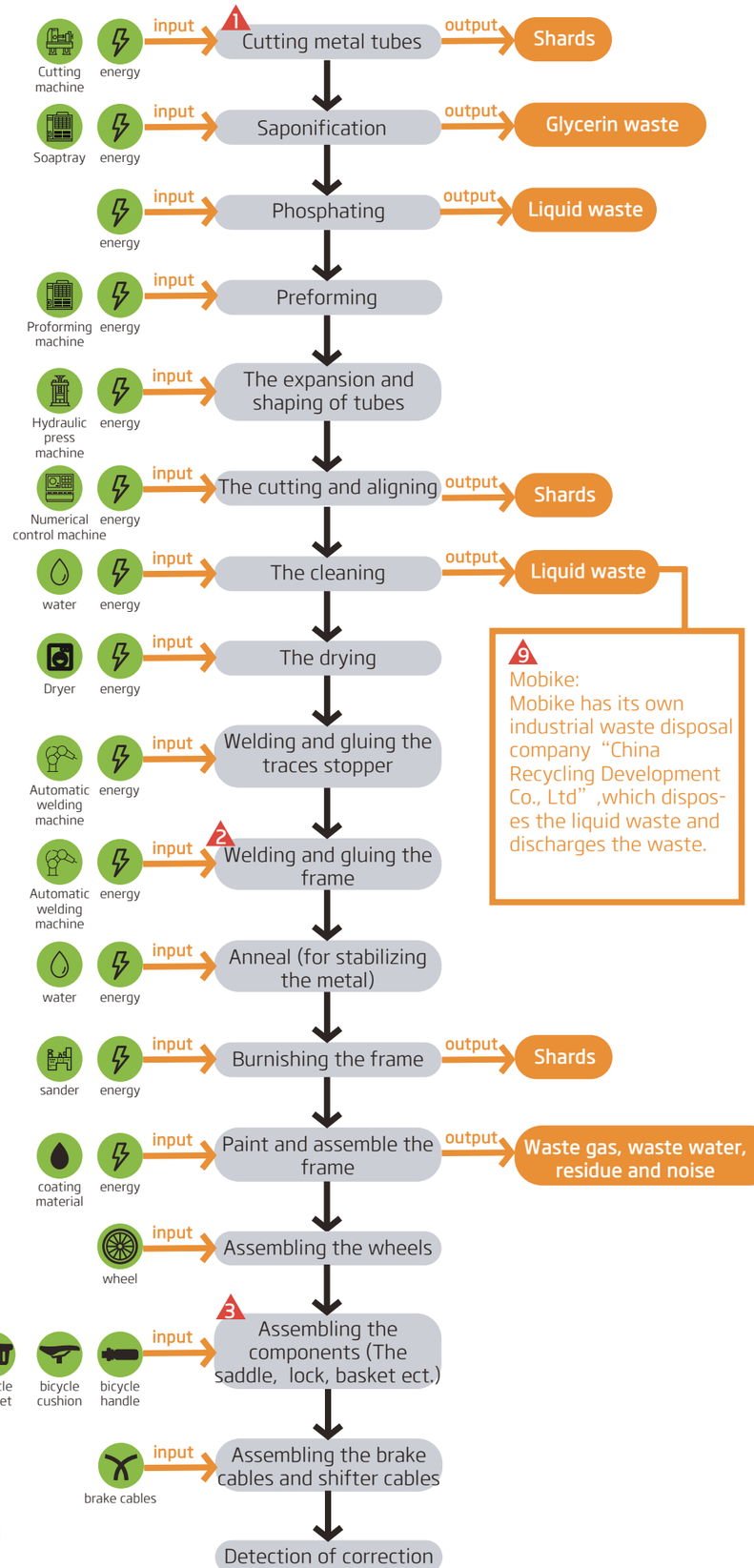
3.1 The general current flow of production

The flow of production of shared bicycle

1 Materials of the metal tubes:

Stainless steel: OFO

Aluminium alloy [Hellobike, Mobike



9 Mobike:
Mobike has its own industrial waste disposal company "China Recycling Development Co., Ltd" ,which disposes the liquid waste and discharges the waste.

2 Welding technology:

Traditional method [OFO:TIG, Hellobike:TIG

New techique: Mobike:MIG

3 Basket techology:

No solar battery : OFO

solar battery [Hellobike, Mobike

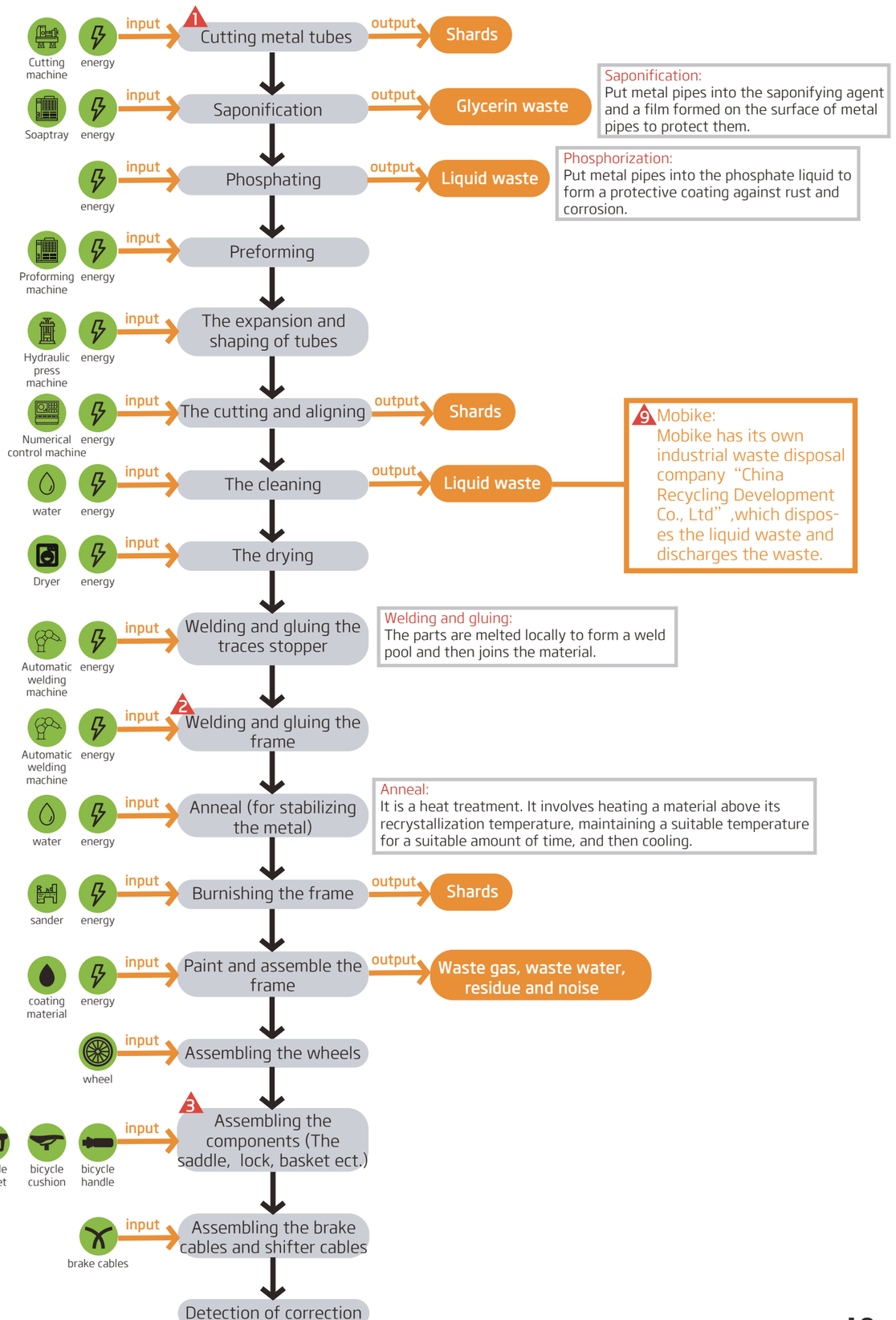
The input in the flow

The output in the flow

The diffrences among the three brand

The flow of production

The flow of production of shared bicycle



Saponification:
Put metal pipes into the saponifying agent and a film formed on the surface of metal pipes to protect them.

Phosphorization:
Put metal pipes into the phosphate liquid to form a protective coating against rust and corrosion.

9 Mobike:
Mobike has its own industrial waste disposal company "China Recycling Development Co., Ltd" ,which disposes the liquid waste and discharges the waste.

Welding and gluing:
The parts are melted locally to form a weld pool and then joins the material.

Anneal:
It is a heat treatment. It involves heating a material above its recrystallization temperature, maintaining a suitable temperature for a suitable amount of time, and then cooling.

The flow of the wheel

4 Bicycle tire (outer) material

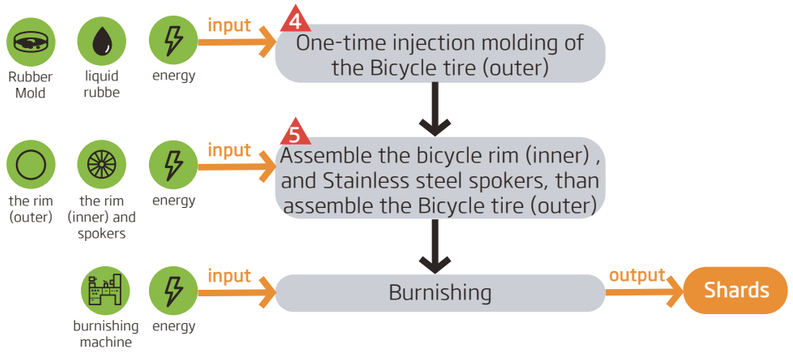
Traditional rubber material [OFO, Hellobike

TEP(A new type of rubber material): Mobike

5 Bicycle rim (inner) material

Stainless steel [OFO, Hellobike

TEP(A new type of rubber material): Mobike



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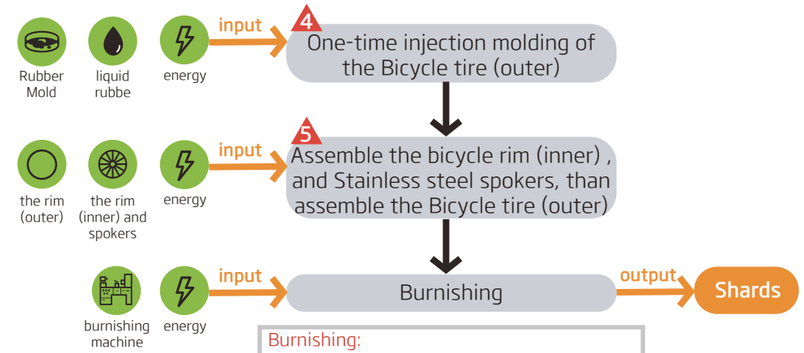


Burnishing:
Use two kinds of material by the friction and make the metal shiner.

The flow of the lock

6 The type of electronic chip

There isn’t electronic chip in OFO

Mobike: MT6261， Support GPS and Bluetooth

Hellobike: SIM，GPS, Bluetooth and Six axis sensor

7 The type of lock

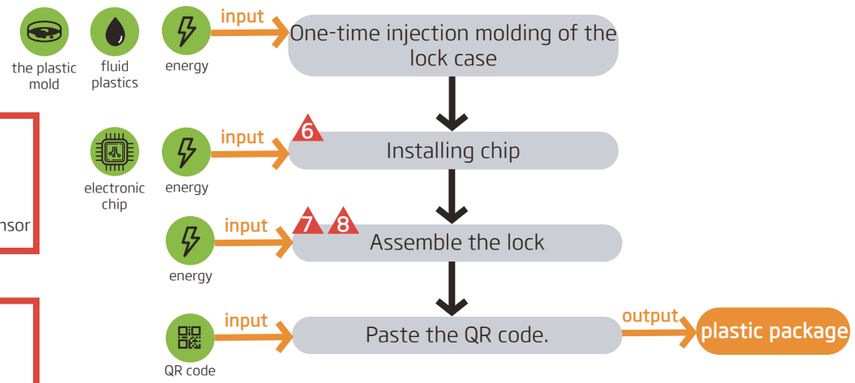
mechanical lock：OFO

Internet of things electronic lock：[Hellobike, Mobike

8 The type of battery

One time battery, unrechargeable：OFO

Rechargeable lithium batteries ，combined with solar panels：[Hellobike, Mobike



The input in the flow

The output in the flow

The diffrences among the three brand

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The flow of the lock

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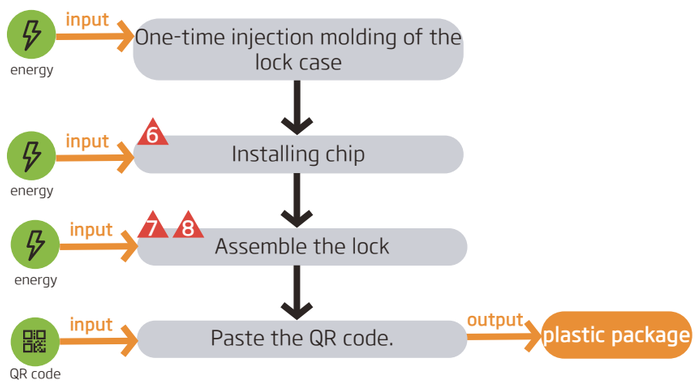


The input in the flow

The output in the flow

The diffrences among the three brand

The flow of production

reference:
https://v.qq.com/x/page/f0563af0c5b.html
http://www.iqiyi.com/w_19rrvlctq9.html
http://bbs.mydigit.cn/read.php?tid=1546306
http://3g.3gtest2.gionee.com/nav/news/detail?act=rec&id=453853
http://www.360doc.com/content/17/0715/10/40557169_671466522.shtml
http://www.360doc.com/content/17/0412/21/7696210_645135838.shtml

3.1.1 The comparison fittings and material

The comparison of the flow of production

	1 Materials of the metal tubes		2 Welding technology		3 Basket techology		4 Bicycle tire (outer) material 5 Bicycle tire (inner) material		6 The type of electronic chip	
	Stainless steel: **Pros:** It can withstand strong impact force, corrosion property and high fatigue strength. **Cons:** When welding, the thermal deformation is larger . It is more difficult to cut. The cost is very high.	**Aluminium alloy:** **Pros:** It is light in weight. The hardness and rigidity is the best in short time. It is good performance, easy molding and no rusting. **Cons:** No elastic, easy to produce metal fatigue. It is easy to convey the ground vibration, resulting in poor riding comfort.	**TIG:** Tungsten Inert Gas Welding. Non melting extremely inert gas tungsten arc protection welding. **Pros:** The price is low. **Cons:** The weld is less durable than MIG and the welding efficiency is low.	**MIG:** Metal inert-gas welding. Inert gas (Ar or He) shielded arc welding with solid core wire. The weld is like fish scale. **Pros:** It is more solid, durable and efficient. **Cons:** The price is high.	**No solar battery:** **Pros:** The price is high. **Cons:** Disposable batteries are likely to cause waste of resources and environmental pollution.	**Solar battery:** **Pros:** It can supply a continuous source of green energy and it is more environmentally friendly. **Cons:** The price is high.	**Outer rim:** **Material:** Rubber **Pros:** Low cost **Cons:** Not durable, no Aging resistance **Inner rim:** **Material:** Stainless Steel **Pros:** High strength, impact resistance, low price. **Cons:** It is heavy.	**Outer rim:** **Material:** TEP **Pros:** Aging resistance, safe, non-toxic, green **Cons:** The price is high. **Inner rim** **Material:** Rubber **Pros:** Light weight and good elasticity. **Cons:** It is low-impact and the price is high.	**No electronic chip:** **Pros:** The cost is low. **Cons:** It is very difficult for users to find bikes. In order to solve this problem, operators have to invest a lot of bikes, resulting in waste and increased cost. The high bike scrapping.	**Electronic chip:** MT6261 SIM, GPS, Bluetooth ect. **Pros:** Live transmission of vehicle location, operators are more accurate to find fault bike (GPS makes it easier for users to find cars). **Cons:** High cost of development and production.
OFO	✓		✓		✓		✓		✓	
Hellobike		✓	✓			✓	✓			✓
Mobike		✓		✓		✓		✓		✓

The comparison of the flow of production

	7 Lock		8 Electric mode		9 Industrial waste disposal	
	Intelligent electronic lock (GPS)	**Mechanical lock (No GPS)**	**Battery:** Use a button battery and a MLO battery. **Pros:** Low cost **Cons:** 1.MLO batteries have problems at high temperatures. 2.It is not rechargeable. Once the battery is exhausted, the user will not be able to unlock it. 3.Disposable batteries are likely to cause waste of resources and environmental pollution.	**Sole Battery:** Use 5.5V “MiaSol é” thin film solar subassembly, which can offer lithium battery at 6000 Ma. **Pros:** 1.It can also supply a continuous source of green energy for modules such as smart locks, GPS and GPRS. 12.it’s very environmentally friendly. **Cons:** The price is high.	**NO**	**YES** Unified disposal and discharge by China Recycling Development Co., Ltd.
OFO		✓	✓		✓	
Hellobike	✓			✓	✓	
Mobike	✓			✓		✓

reference:
https://baike.baidu.com/item/MIG%E7%84%8A
http://www.zgzszy.com/english/
https://baike.baidu.com/item/TIG%E7%84%8A
https://mp.weixin.qq.com/s?__biz=MzIxNTQw-MzI4OQ==&mid=2247489781&idx=1&sn=725fe688225f3992445165aa8a91c17d&chksm=97998683a0ee0f956b1fbb9b810b9313c747a99c1f41d0acd2abf1193b289d24656740733ac2&scene=21#wechat_redirect
http://www.ednchina.com/news/article/20170620bike
https://zhidao.baidu.com/question/156907685.html
http://www.motorfans.com.cn/thread-111073-1-1.html
http://bbs.tiexue.net/post2_8902244_1.html
http://baijia-hao.baidu.com/s?id=1570350507317906&wfr=spider&-for=pc

Detail analysis of Mobike

You can adjust the seat, but you need the tools to turn it on and off.

Electronic locks, people can scan the qr code to open it

The structure of the bicycle is made of stainless steel.

Two ply tires, and the outer rubber tires are solid. Prevent blowout and reduce bumps

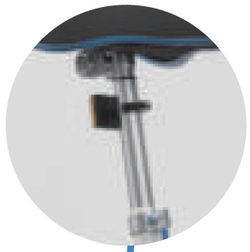
enclosed chain drive， It eliminates chain damage, reduces dust, reduces noise, and avoids accidental rolling into clothing.

The solar panels in the bicycle's basket provide electricity for its electronic locks

Detail analysis of OFO

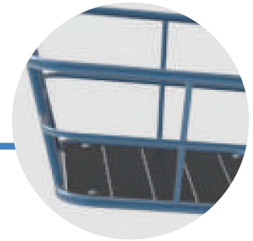
Detail analysis of Hellobike

The intelligent electronic lock contains GPS, which is convenient for users to find the bike.



The seat post cannot be adjusted by users themselves except for a special tool.

The frame is made of aluminium alloy, which is light in weight.



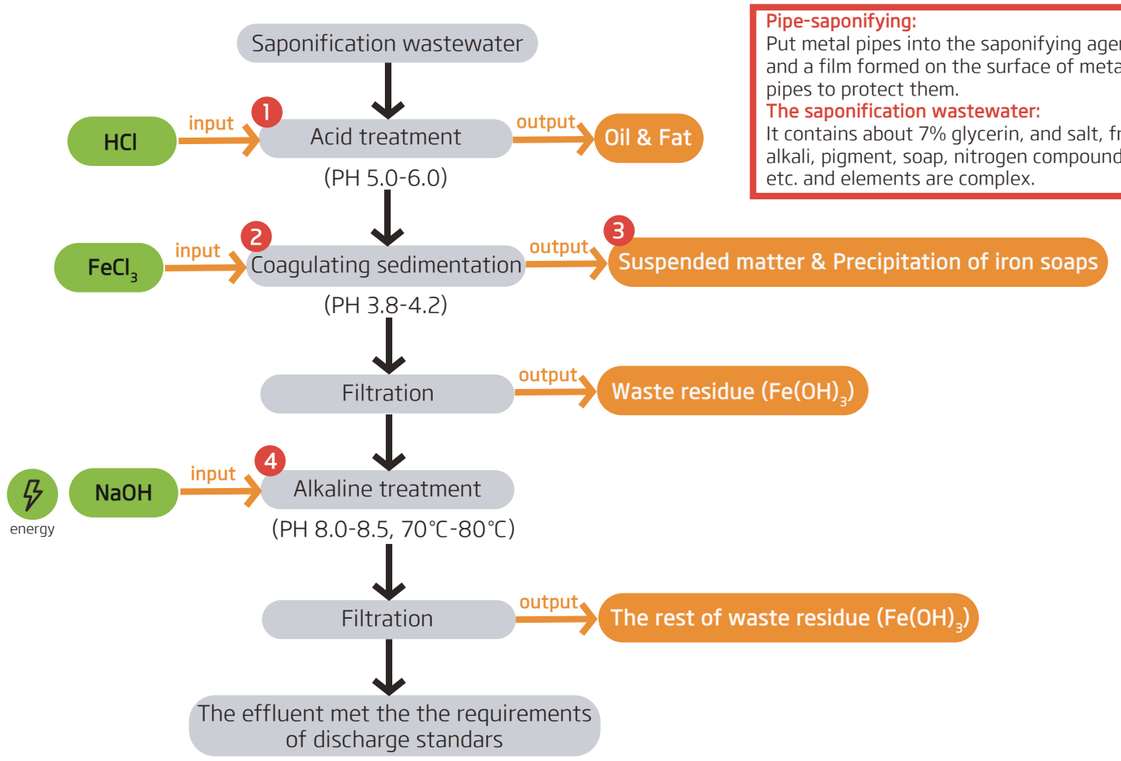
It contains solar penal in thebasket. The penal provides green energy for the lock.

The solid tyre is more durable.

It is the high-efficiency chain transmission. It can avoid chain dropping in the driving.

3.1.2 The comparison of the current flow and proposal flow in saponification

The current flow of saponification wastewater



Pipe-saponifying:
Put metal pipes into the saponifying agent and a film formed on the surface of metal pipes to protect them.
The saponification wastewater:
It contains about 7% glycerin, and salt, free alkali, pigment, soap, nitrogen compound etc. and elements are complex.

1 Acid treatment
Add HCl into the wastewater to break the structure of oil, which are suspended on the surface of the liquid. Then it is simple to filter it. The purpose of acid treatment is to remove oil from wastewater.

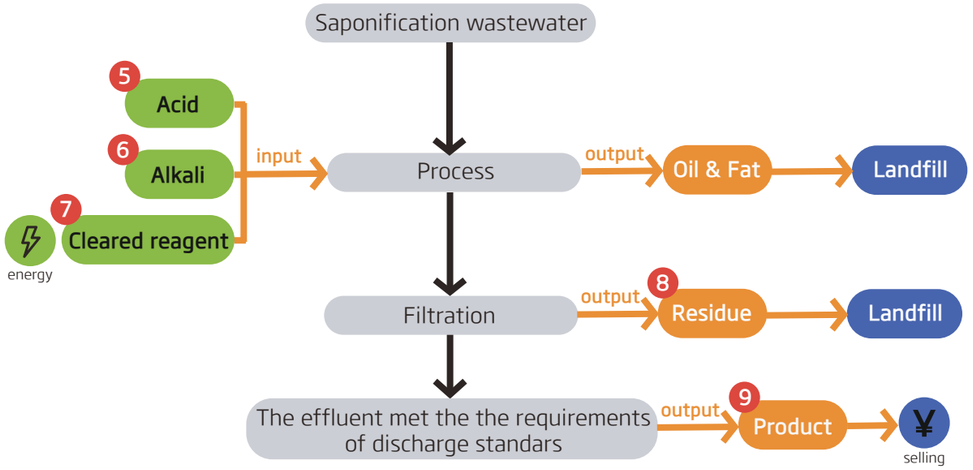
2 Coagulating sedimentation
$FeCl_3$ is added as a precipitant to adsorb the loose impurities in the liquid and make it lump to the bottom of the liquid.

3 Iron soaps
A black brown solid could pollute the enironment.

1 Alkaline treatment
The excess $FeCl_3$ in the third step is changed into $Fe(OH)_3$ precipitate by adding caustic soda (NaOH). The NaOH could adjust the pH value to neutral.
$FeCl_3+3NaOH=Fe(OH)_3\downarrow+3NaCl$

The input in the flow
The output in the flow
Attention
The flow of production

The proposal flow of saponification wastewater



5 Acid
The function of acid is like ①, removing the oil.

6 Alkali
The function of alkali is to adjust the pH value to neutral.

7 Cleared reagent
The cleared reagent is a kind of plymer. The interaction of the plymer adsorbes impurities in the liquid and they absorb the impurities into large precipitates for filtering.

8 Residue
Impurities gathered through the cleared reagent ⑦.

9 Product
It is the pure glycerol.

Comparison betweent the current / proposal flow of the treatment of saponification wastewater

The current flow	The proposal flow
1. The whole process needs the filtration for many times and labor intensity increases. (the whole processing time is 8h)	1. The whole process just needs the filtration for one time and it is simple to operate. (the whole processing time is 6h)
2. The PH value in the process is acidic and adding a lot of NaOH increases the cost.	2. The PH value in the process is close to neutral. It saves the amount of NaOH.
3. Because of the Fe^{3+} the by-product: glycerol is not pure.	3. Because the reagent does not contain Fe^{3+}, the extra product glycerin is pure and it can get extra income.
4. The chemical has strong stimulant. The operating environment is not well.	4. G409 and PHP are non-toxic, harmless and odourless, and its operating environment is good and the process is more environmentally friendly.

Saponification

After cutting metal tubes is the step of saponification. The saponification is a critical step of metal tubes production. This step is carried out in saponification tank. Saponification is mainly to soak the metal tube in a certain proportion of the saponifying agent, during a series of chemical reactions to make the metal tube surface a layer of soap film. This soap film could protect the tube. The saponifying agent contains caustic soda (NaOH), sodium carbonate (Na_2CO_3), trisodium phosphate (Na_3PO_4), sodium pyrophosphate ($Na_4P_2O_7$), sodium silicate (Na_2O_3Si), sodium tetraborate ($Na_2B_4O_7.10H_2O$) etc., which are alkaline [1].

The main reactions in the saponification process are as follows [2]:

$CH_3COOC_2H_5+Na^++OH^-=CH_3COO^-+Na+C_2H_5OH$

$Al_2O_3+2NaOH=2NaAlO_2+H_2O$

After the saponification the wastewater contains about 7% glycerin, salt, free alkali, pigment, soap, nitrogen compound etc. and elements are complex [3]. At present, in China, factories use ferric chloride ($FeCl_3$) to treat this wastewater (Pic.The current flow). The first step is the acid treatment that is, adding hydrochloric acid to demulsifier in the waste liquid. Demulsification is the breaking of a crude oil emulsion into oil and water phases [4]. During this process the oil and fat floats on the surface of liquid and removes. After this, it is the coagulating sedimentation. Ferric chloride was added to the liquid after the previous reaction. As a precipitator, ferric chloride mainly converts the hard soap in the waste water into iron soap and adsorbs some impurities into suspended matter. Afterwards, the precipitant ferric hydroxide ($Fe(OH)_3$) from the reaction of ferric chloride with caustic soda is removed. Then it is the alkaline treatment. The excess ferric chloride in the third step is changed into ferric hydroxide precipitate by adding caustic soda. This step requires temperature control between 70 and 80 degrees Celsius. After the ferric hydroxide precipitation is removed again, the rest of waste liquid can meet the national emission standards and discharge.

The main reactions in the saponification process is as follows:

$FeCl_3+3NaOH=Fe(OH)_3\downarrow+3NaCl$

The problems in current flow:

1. The whole process needs two filtration, not only complicated operation, but also increased labor intensity. The process takes 8 hours to complete and takes a long time.
2. Ferric chloride as a precipitant requires pH value, and it must be controlled between 3.8-4.2. The pH value in the process is acidic. In order to reach the final discharge standard, a large amount of caustic soda is needed and this increases the cost.
3. Glycerol, the by-product, is impure because of the addition of ferric chloride as a treatment agent (especially because of the brown-red color of iron ions).
4. The process produces more waste, such as iron soap, ferric hydroxide precipitation and so on. At this stage, these products have not been properly treated, factories choose to landfill or discard. This would pollute the envi

ronment. It is worth mentioning that the brown-red color filter residue produced in the process is difficult to remove, resulting in poor operation environment.
5. According to the calculation of 2000 tons per year, each ton of treatment needs f hydrochloric acid 7.9 yuan, caustic soda 8.16 yuan, ferric chloride 6 yuan. Labor force costs 0.45 yuan, electricity 1.24, water 4 yuan and other expenses, the current process will cost about 600,000 yuan per year [5].
Organize and analyze the information gathered by consulting the relevant literature, we find the new process (Pic. The new flow). The acid treatment steps are changeless, and the oil and fat floating on the surface are removed. Next, alkali treatment was carried out directly. G490 and PHP were added as cleared reagent in the new process. G409 and PHP are both polymers. G409 is yellow or light grey liquid and PHP is a white powder. These two polymers can be prepared or purchased. We consider the purchase situation here. G409 acts as coagulation and precipitation during the reaction, flocculating and precipitating the impurities in the liquid and adsorbing and encapsulating them into nucleus. Nucleus is a stage in the formation of precipitation. It is generally believed that during the precipitation process, the isomorphous ions form nucleus in supersaturated solution and then grow into crystalline precipitates. PHP is a long-chain structure that acts as a net. In the process of reaction, G409 must be added first to form incompact sediment, and then PHP is added to make it condense into large molecules sediment. It should be noted that before adding the two polymers, the temperature should be controlled between 70 and 80 degrees Celsius, and then the pH value should be adjusted to 8.0-8.5 by adding caustic soda. After the reaction is finished, only one filtration is needed to remove the flocculation. In the last stage, the pH value of the wastewater is neutral, which is more clear and can be discharged directly. At the same time, the extra product, glycerol, is good in color and purity, and can be sold as extra profit.

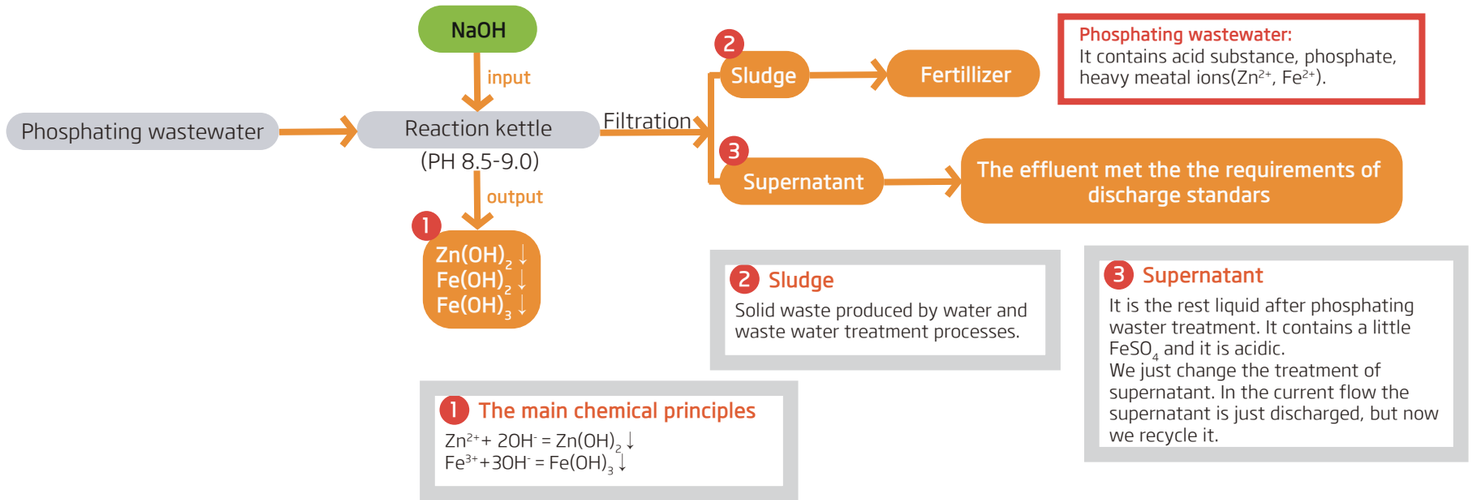
The advantages of the new flow:
1. The new process only needs 6 hours and only one filtration to the whole process more convenient. The labor intensity is reduced, and the efficiency is improved.
2. The pH value of the liquid is close to neutral (5.0-5.5) in the process, thus saving the caustic soda in alkali treatment.
3. Because the reagent does not contain iron ions, the amount of colored pollutants is reduced and the equipment is easy to clean. After avoiding using ferric chloride, the extra product glycerol is more pure, and the factory can get extra income by recycling it.
4. G409 and PHP are nontoxic, harmless and inodorous, and the final waste liquid is clear. These two precipitators have strong cohesion, and the precipitates are easy to clean up. This makes the operation environment better and the process more environmentally friendly.

[1] http://www.tongzhujian.com/ziview174.html
[2] [5] 《Chemical Treatment of Waste Pipe-Saponifying Solution》 Yu Guoshen
[3] 《Study on New Purificatory Technology for Saponification Water》 Liang binhua, Zhao zhichuan, Chen Wen
[4] http://muchong.com/html/200705/467999.html

3.1.3. The comparison of the current flow and proposal flow in phosphating

3.1.3.1 The comparison of the current flow and proposal flow in phosphating wastewater

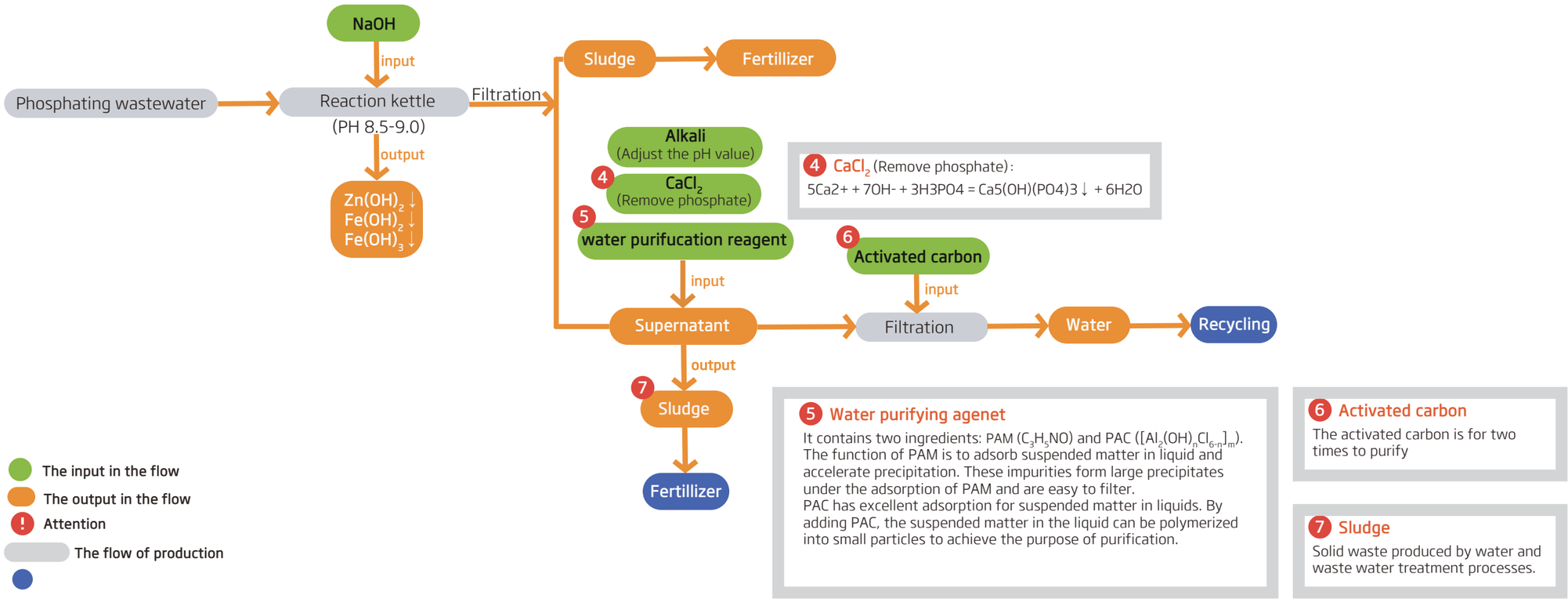
The current flow of the treatment of phosphating wastewater



Comparison betweent the current /proposal flow of the treatment of phosphating wastewater

The current flow	The proposal flow
Although the stages are simple, the products in the flow are not recycled. It is wasteful for the water resource.	1. The whole system is clear and the operation is easy. The system is running stable.
	2. It recycles the water resource so the factory can save the cost of water.
	3. The new flow has good effect of phosphorus removal and the clearance is over 96%. Especially, the PAM accelerates the process of flocculation.

The proposal flow of the treatment of phosphating wastewater

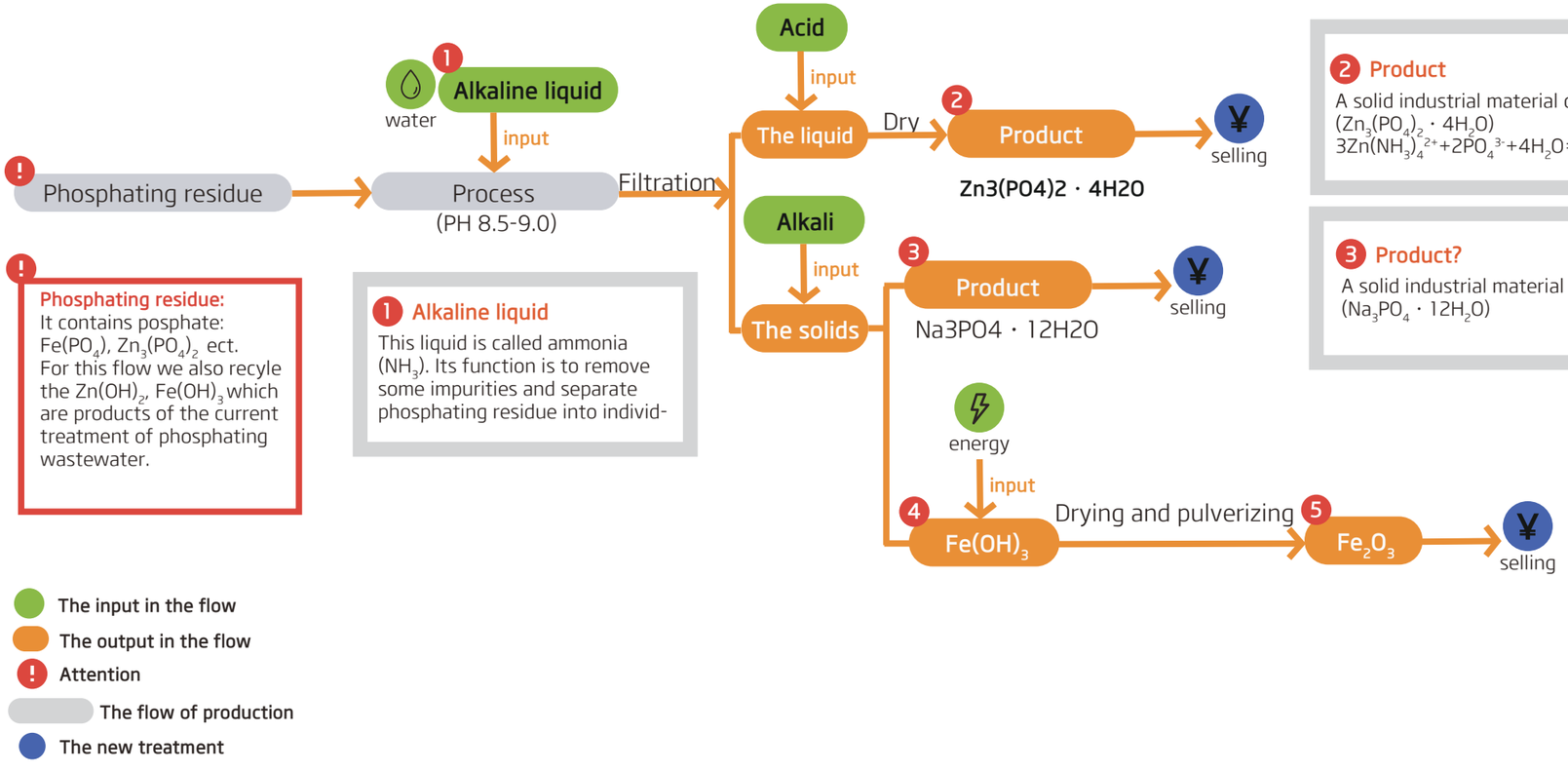


3.1.3.2 The comparison of the current flow and proposal flow in phosphating residue

The current flow of the treatment of phosphating residue

At present, the factory does not pay attention to the this residue. Many factories do not have any treatment for this residue and they put phosphating residue into landfill directly. This is not reasonable.

The proposal flow of the treatment of phosphating residue



Comparison betweent the current / proposal flow of the treatment of phosphating residue

The current flow	The new flow
In current situation, the phosphating residue is not treated. The factory just throw it away after the filtration. This behavior is a waste of the meatal resource and it causes environmental pollution.	1. Apart from the phosphating residue, three kinds of precipitates in the 'Phosphating wastewater treatment flow' have been reused. The products after the treatment in the new flow can get extra income.
	2. The whole process does not generate secondary pollution and is more environmentally friendly.
	3. The new operation is simple and low consumption.

3.1.3.3 The waste in the process of phosphating

Phosphating is a process in which metal parts are immersed in phosphate liquid (some acid phosphate solution) and a layer of crystalline phosphate film is deposited on the surface, which is insoluble in water. This process is aim to protect metal pipes from dust and corrosion. Phosphating is an important procedure in metalworking. As for the manufacturing process of bicycles, the following steps are needed for the phosphating of aluminum pipes. First, the aluminum tube is immersed in the phosphate liquid. The main ingredients of phosphate liquid are $Fe(H_2PO_4)_2$, $Mn(H_2PO_4)_2$, $Zn(H_2PO_4)_2$ and this process need the acceleration F+. This process is carried out in the reaction tank, and the reaction environment needs to be heated to 50-70 degrees. After 5-15min, waste residue and reaction waste liquid were found in the reaction tank. At this point, the aluminum tube is taken out and dried at 120 degrees -160 degrees in order to dry 5-10min.

The main reactions in the phosphating process are as follows : (1)

$3Zn(H_2PO_4)_2 = Zn_3(PO_4)_2 \downarrow + 4H_3PO_4$

$Fe + 3Zn(H_2PO_4)_2 = Zn_3(PO_4)_2 \downarrow + FeHPO_4 \downarrow + 3H_3PO_4 + H_2 \uparrow$

The phosphating waste water contains acid substance, phosphate, heavy metal ions (Zn^{2+}, Fe^{2+}). At present, the treatment adopted by the factory is to add caustic soda into the phosphating waste liquid. After the reaction, the precipitant containing $Zn(OH)_2$, $Fe(OH)_2$ and $Fe(OH)_3$ are left in the reaction tank. After filtration there are two products: sludge and supernatant. The sludge can be used as fertilizer and the supernatant is directly discharged. Although sludge has been utilized in this process, a large amount of water resources have been wasted by direct discharge of supernatant. Organize and analyze the information gathered by consulting the relevant literature, we can know that the supernatant can get more pure water through certain treatment, and the water can be recycled.

The main chemical principles involved are as follows:

$Zn^{2+} + 2OH^- = Zn(OH)_2 \downarrow$

$Fe^{3+} + 3OH^- = Fe(OH)_3 \downarrow$

The main components of supernatant are acidic feso4 and a small amount of phosphate. It is suggested that the supernatant be treated as follows:

First, alkali was added to the supernatant to adjust the pH value to 10.5. The liquid is then transferred to the phosphorus removal tank and added to the $CaCl_2$ to form $Ca_{10}(PO_4)_6(OH)_2$ precipitate by the reaction of $CaCl_2$ with the PO_4^{3-} in the solution so that the phosphate in the waste liquid is removed. The liquid was then transferred to the coagulation tank to add the water purifying agent PAC. PAC is a polymerized alumina that has excellent adsorption for suspended matter in liquids. By adding PAC, the suspended matter in the liquid can be polymerized into small particles to achieve the purpose of first purification. These liquids with small particle impurities are introduced into the plume pool and then added to PAM. PAM is a kind of coagulant aid. Its function is to adsorb suspended matter in liquid and accelerate precipitation.

There are small particles of impurities in the liquid after the previous treatment. These impurities form large precipitates under the adsorption of PAM and are easy to filter.The sludge produced in thisstep can be used as fertilizer.
The filtered liquid is added with a small amount of activated carbon for two times to purify, and the used activated carbon can be discarded. The second purification liquid is neutralized with a small amount of acid, and the water obtained after stable pH is reused into the water recycle tank. The water can be used for daily clean water in factories.
The main chemical principles involved are as follows:
$5Ca^{2+} + 7OH^{-} + 3H_3PO_4 = Ca_5(OH)(PO4)_3 \downarrow + 6H2O$
The advantages of the proposal flow:
1. The whole processing system is clear, and the operation is carried out in the reaction tank to save labor force and operate simply. The system is running stable.
2. Because of the large amount of water used in the phosphating process, the waste water is also a large amount. It recycles the water resource so the factory can save the cost of water.
3. The new flow has good effect of phosphorus removal and the clearance is over 96%. Especially, the PAM accelerates the process of flocculation.
4. According to the calculation of 26,000 tons per year, each ton of treatment needs row material fee 1.93 yuan, labor force costs 0.45 yuan, electricity 1.24 yuan and water 4 yuan. The cost of the new process is about 3.62 yuan /t. The annual processing fee is 94,120 yuan. In the new process, the water recovery rate reaches 90%, and the annual water cost could be saved about 93,600 yuan.

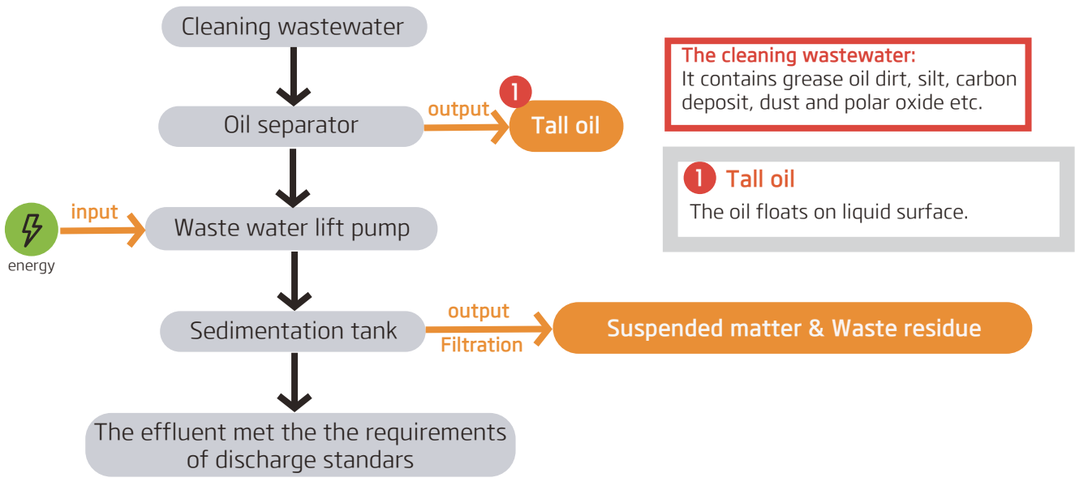
At present, the treatment of phosphating residue is put into landfill directly. It not only wastes resources but also pollutes the environment. The main components of phosphating residue are $FePO_4$ and $ZnPO_4$. Apart from treating and recovering the original phosphating residue, it is suggested that the proposal process can also treat the precipitation of $Zn(OH)_2$ and $Fe(OH)_3$ produced by alkali treatment in the phosphating wastewater process. These four solid wastes were added to the reaction tank, and the reaction was carried out by adding ammonia and water. Liquid and solid substances can be obtained by filtration. $Zn_3(PO_4)_2$. $4H_2O$ can be obtained by adding phosphoric acid to the liquid and drying. The matter can be sold for profit. Adding caustic soda to the solid substance, it could get the$Na3PO_4$. $12H_2O$.This matter also can be sold for profit. The main component of the remaining reaction is $Fe(OH)_3$. We give two treatments: the first one is directly dried by electric power, and the Fe_2O_3 can be obtained after pulverizing. Fe_2O_3 can be used as an industrial material for extra profits.
The main reactions in the phosphating process are as follows:
$3Zn(NH_3)_4^{2+} + 2PO_4^{3-} + 4H_2O = Zn_3(PO_4)_2 \cdot 4H_2O \downarrow + 12NH_3$
$FePO_4 \cdot 2H_2O + 3NaOH = Fe(OH)_3 \downarrow + Na_3PO_4 + 2H_2O$
$2Fe(OH)3 \rightarrow Fe2O3 + 3H2O$

The advantages of the proposal flow:

1. Apart from the phosphating residue, three kinds of precipitates in the ‘Phosphating wastewater treatment flow’ have been reused. The products after the treatment in the new flow can get extra income.
2. The whole process does not generate secondary pollution and is more environmentally friendly.
3. The new operation is simple and low consumption.
4. According to the above process, the recovery rate of Zn is 95%, and the recovery rate of Fe is 98%. Zn in phosphating residue accounted for 5% and Fe accounted for 15%. One ton of phosphating residue can recover 105kg $Zn_3(PO_4)_2 \cdot 4H_2O$, 210 kg Fe_2O_3, and 1300 kg PFS. According to the market price, Zn3(PO4)2 · 4H2O 9000 - 13000 yuan / t,Fe_2O_3 1800 - 5000 yuan/ t, PFS 800 - 1000 yuan/t. It is known that the recovery of phosphating residue can be a considerable additional income for the factory.

3.1.4 The comparison of the current flow and proposal flow in cleaning wastewater

The current flow of cleaning wastewater



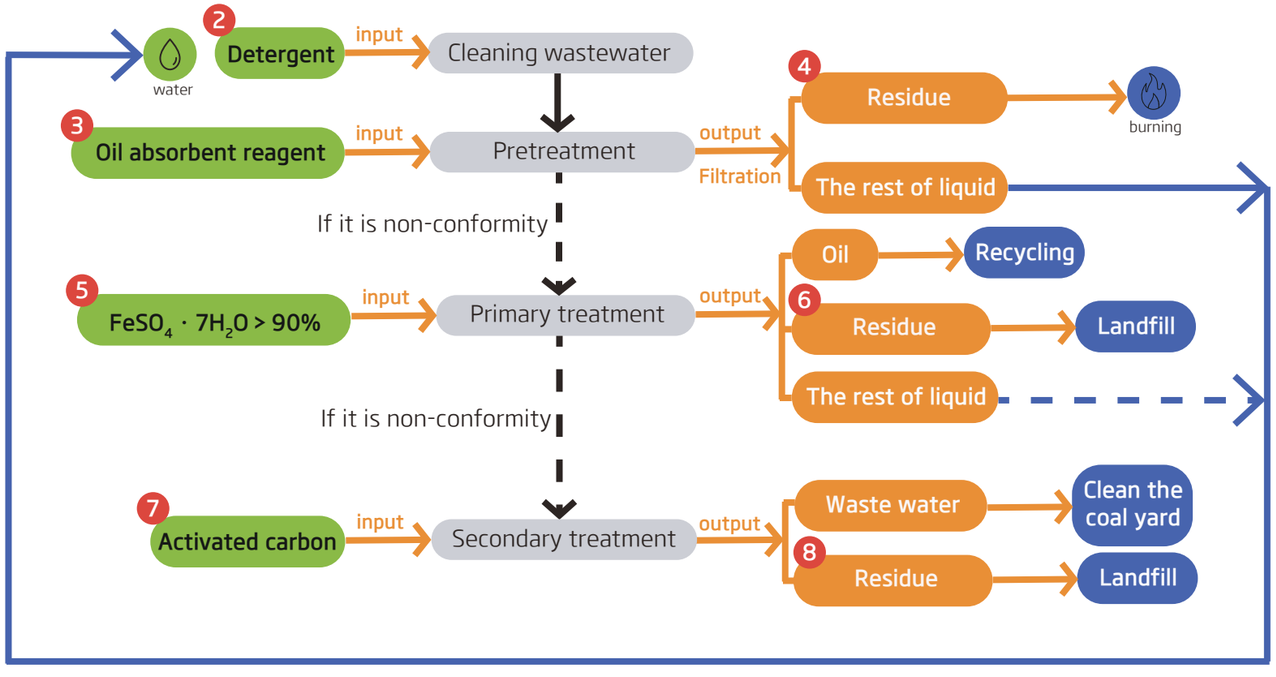
The cleaning wastewater:
It contains grease oil dirt, silt, carbon deposit, dust and polar oxide etc.

1 Tall oil
The oil floats on liquid surface.

Comparison betweent the current / new flow of the treatment of cleaning wastewater

The current flow	The new flow
1. There is no treatment about suspended matter and waste residue.	1. The suspended matter and waste residue are treated complying with the national technical specification.
2. At the end of wastewater treatment is only discharge and it is not utilized.	2. With the primary treatment and secondary treatment the factory recycles not only the emulsufing oil (it can be used as detergent) but also the water. The cost of the water is saved.

The proposal flow of cleaning wastewater



2 Detergent
The cleaning water contains dirt and dust removing with detergent.

4 Residue
The solid waste after the reaction of oil absorbent reagent.

6 Residue
The soild waste after the reaction of $FeSO_4$.

8 Residue
The soild waste after absorbtion of active carbon in waste water.

3 Oil absorbent reagent
It is the product after modification of expanded perlite. The way to use it is to put it on the water surface.

5 $FeSO_4 \cdot 7H2O > 90\%$
If the waste water contains a large amount of oil, use $FeSO_4$ to clarify the oil.

7 Activated carbon
The powdered activated carbon used for absorption of oil.

- The input in the flow
- The output in the flow
- Attention
- The flow of production
- The new treatment

Cleaning wastewater

After the stage of cutting and aligning is the cleaning. The purpose of this stage is to remove solid waste and liquid waste. Industrial washing usually uses the method of spraying.
The cleaning water contains grease oil dirt, silt, carbon deposit, dust and oxide [1]. The first step of current process (Pic.The current flow) is pouring wastewater into oil separator to stand still until the oil floating on the surface and then, it is removed. After this, the rest of liquid is fed into sedimentation tank by the waste water lift pump. This process consumes the energy. After holding, the suspended matter and waste residue are filtered. In the last stage the effluent meets the requirements of national discharge standards. To sum up, the physical methods adopted at the present stage cannot completely remove pollutants from sewage.

The problems in current flow:
1. In the whole process, the products after reaction: tall oil and solid waste have not been properly disposed. These wastes are directly discarded to pollute the environment.
2. The amount of water required for cleaning is relatively large, and the liquid waste after treatment is directly discharged. It wastes water resources. We can consider recycling.
Organize and analyze the information gathered by consulting the relevant literature, we find the new process (Pic.The new flow). Generally speaking, the new process is divided into three main steps: pretreatment, primary treatment and secondary treatment.

The ideas of the treatment are as follows:
1. The suspended solids, tall oil and sediment in the waste water are filtered by physical static precipitation method.
2. Demulsification and salting out are used to separate oil with ferric sulfate ($FeSO_4$).
3. The wastewater was purified by the adsorption of activated carbon.
The first stage is to put the detergent and water into wastewater. To begin with the pretreatment, the inorganic oil absorbent chemical which is the product after modification of expanded perlite is put into the liquid. This inorganic oil absorbent chemical has light specific gravity and the price is low. It is also very convenient to use; just put it on the surface of the liquid. After the reaction we can get two products: suspended matter and waste residue occupied 5% and the rest of liquid [2]. Suspended matter and waste residue are burned. When the remaining liquid is clear, this part of the liquid can be recycled as the first part of the water needed. If the remaining liquid is turbid, it must be further processed. The primary treatment is to put ferric sulfate into the remaining liquid. After the demulsification, there are three products: the emulsifying oil on the surface of liquid, the waste residue under the container and the liquid after demulsification. The emulsifying oil is a kind of industrial material and it should be recycled. The waste residue is directly transported in the landfill.

The remaining liquid contains a small amount of oil and cleaning agent, which can be recycled as the complementary cleaning agent [3]. After this liquid has been recycled many times, it is necessary to carry out the secondary treatment when the water quality is not up to standard. Hydrogen peroxide, which accounts for 0.05%-0.1% of total mass, and ferric sulfate, which accounts for 0.1%-0.2% of total mass, are used as catalysts in the liquid. After the reaction was finished, activated carbon was added to adsorb residual oil. The secondary treatment took 2 hours. The remaining liquid in this step can be used as daily clean water for factories, such as coal yard watering. The powdered activated carbon used for reaction is directly buried after adsorption of oil.

The advantages of the new flow:

1. The solid waste in the cleaning wastewater is properly treated, and the advanced treatment is adopted to make the solid waste meet the environmental protection standard.

2. Achieve water recycling through hierarchical treatment, and save water costs of factories. The primary and secondary treatments are spare process, which are more systematic and provide more choices for the factory. Emulsifying oil can be used as a detergent to recycle and save a certain cost. The treatment agent used in the process is low in price and good in effect. At the same time, ferric sulfate has little effect on the PH value of the liquid and can better recycle water All the products in the flow meet the environmental protection requirements.

3. According to the calculation of 1 650 tons per year, each ton of treatment needs ferric sulfate 165 yuan, hydrogen peroxide 0.6 yuan, inorganic oil absorbent chemical 1.4 yuan. Labor force costs 0.45 yuan, electricity 1.24, water 4 yuan and other expenses, it will cost about 25,000 yuan. The percent recovery of wastewater can reach more than 50%, that is to say, at least 625 tons of water can be recovered every year, and the cost of water can be saved by 2500 yuan.

[1] http://blog.sina.com.cn/s/blog_ad0f5d0e0102v8ef.html
[2] [3] http://www.cqvip.com/read/read.aspx?id=1463960

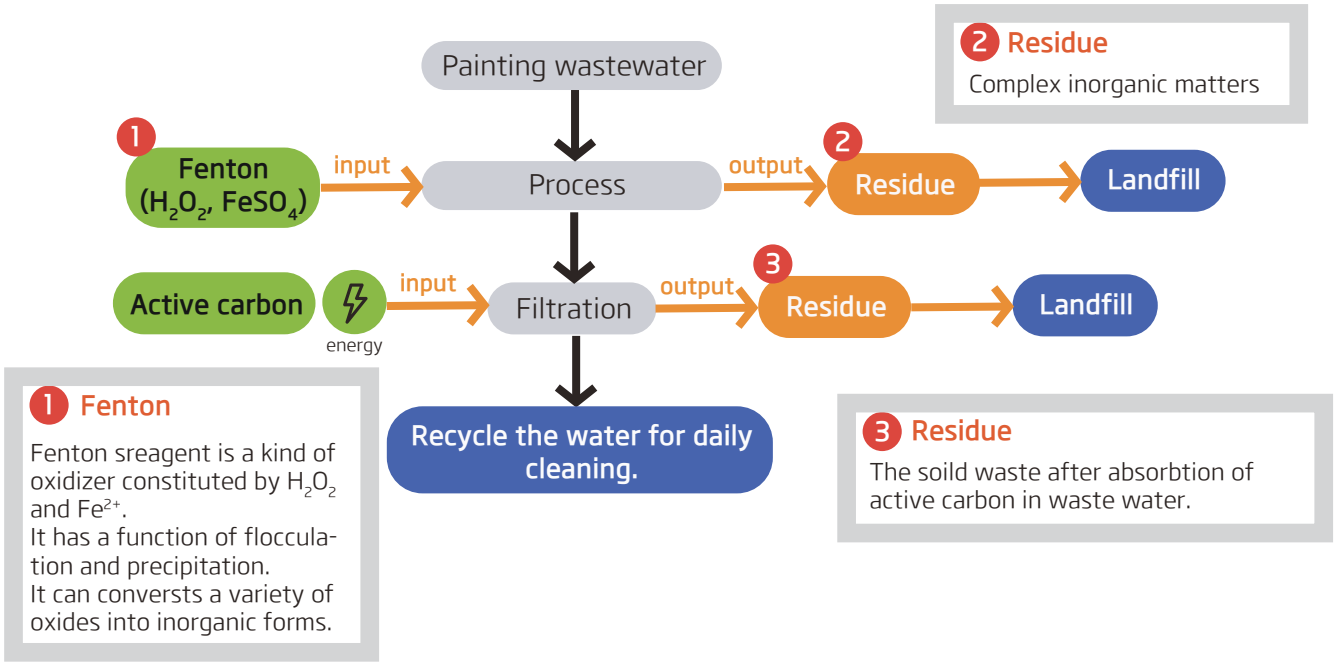
3.1.4 The comparison of the current flow and proposal flow in cleaning wastewater

The current treatment of painting wastewater

Because the quantity of paint wastewater is not too much for every factory, the factory does not pay attention to the this wastewater. Many factories treat it as sewage, and even some factories discharge directly. This is not reasonable.

The painting wastewater:
It contains solvent coating, metal salt, acid, alkali, particle etc.

The proposal flow of painting wastewater



The advantages of the new treatment

1. The operation is simple, and the factory do not need extra labor force . The the equipment is easy to get.

2. After the treatment above, the painting wastewater is reused without any need for external drainage and it achieves the goal of protecting the environment. At the same time, the cost of water is saved.

The input in the flow
The output in the flow
Attention
The flow of production
The new treatment

Painting wastewater

Because the amount of spraying wastewater is relatively small, the factory has not taken corresponding treatment for painting wastewater, but choose to discharge directly. The content of chemical oxygen demand (COD), suspend solid (SS), Total Nitrogen (TP) and biochemical oxygen Demand (BOD) in painting wastewater is not low, and direct discharge is harmful to the environment.

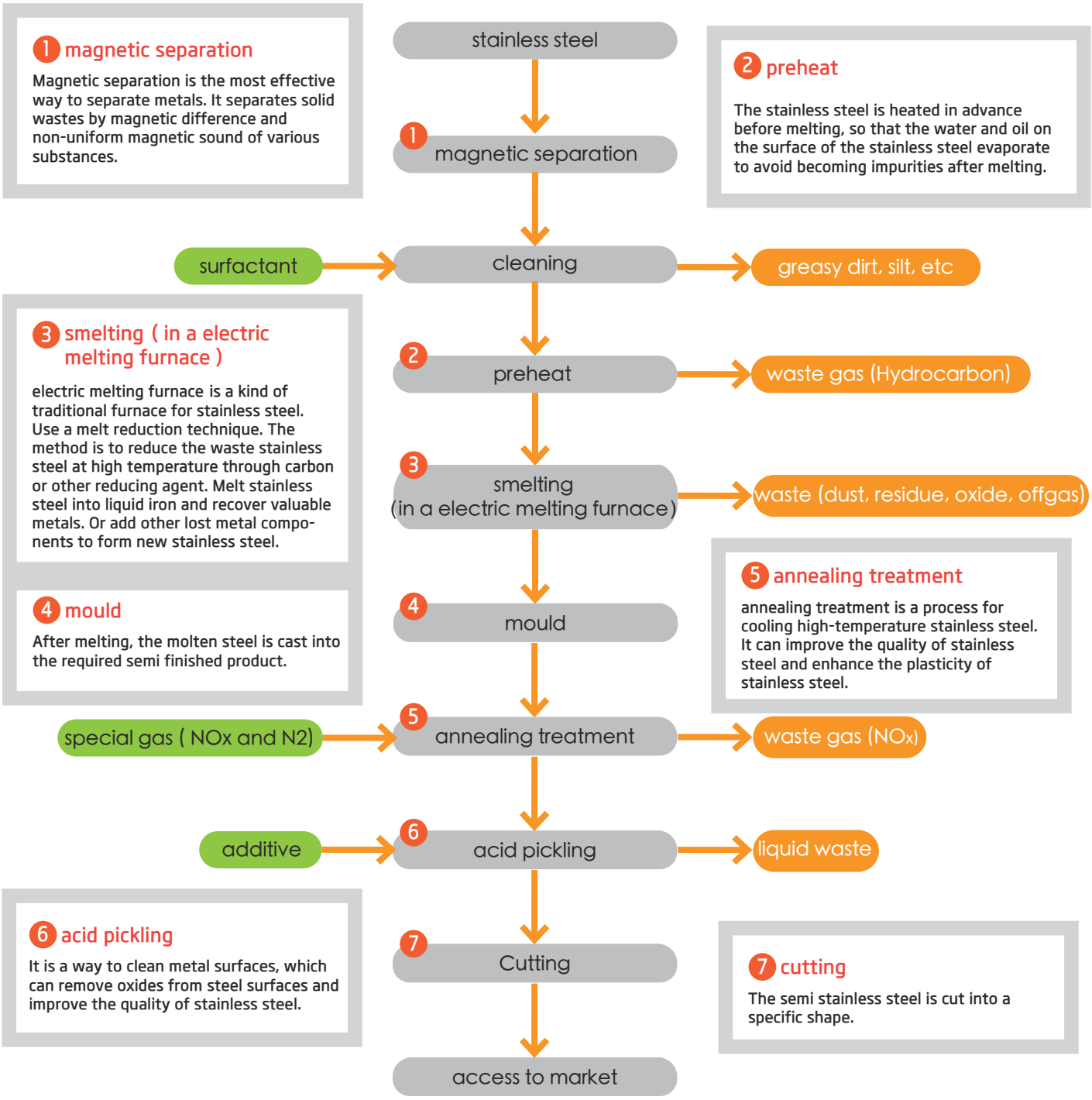
We recommend the proposal flow to be treated with Fenton reagent. It is effective, low-cost and is convenient to use. First, the painting wastewater is injected into the oxidation coagulant tank and added with Fenton reagent. Fenton reagent is a strong oxidant obtained from the mixture of H_2O_2 and $FeSO_4$, which can oxidize organic pollutants in water and eventually turn them into small molecules such as CO_2, water and inorganic salts. That is to say, Fenton reagent decomposes COD, SS, TP, BODs in painting wastewater into inorganic small molecule precipitates, which are non-toxic, harmless and can be directly put into landfilled. Then activated carbon is added to the remaining liquid for adsorption. The impurities in the waste liquid are further removed to achieve the purpose of secondary purification. The liquid after reaction is filtered through an electric filter to remove scum and precipitates. The remaining liquid is stored in the water recycling tank, which can be used as a daily clean water for the factory.

The advantages of the proposal flow:

1. The operation is simple, and the factory do not need extra labor force . The the equipment is easy to get.
2. After the treatment above, the painting wastewater is reused without any need for external drainage and it achieves the goal of protecting the environment. At the same time, the cost of water is saved.
3. According to the annual calculation of 1000 tons, the cost of raw materials and processing costs will be 4500 yuan. The process can recover 95% of the water and 4 yuan per cubic meter of water, which can save the water cost about 3800 yuan for the factory.

3.1.6 The comparison of the current flow and proposal flow in recycling stainless steel

The old flow of recycling stainless steel



Problems analysis in current flow of recycling aluminium

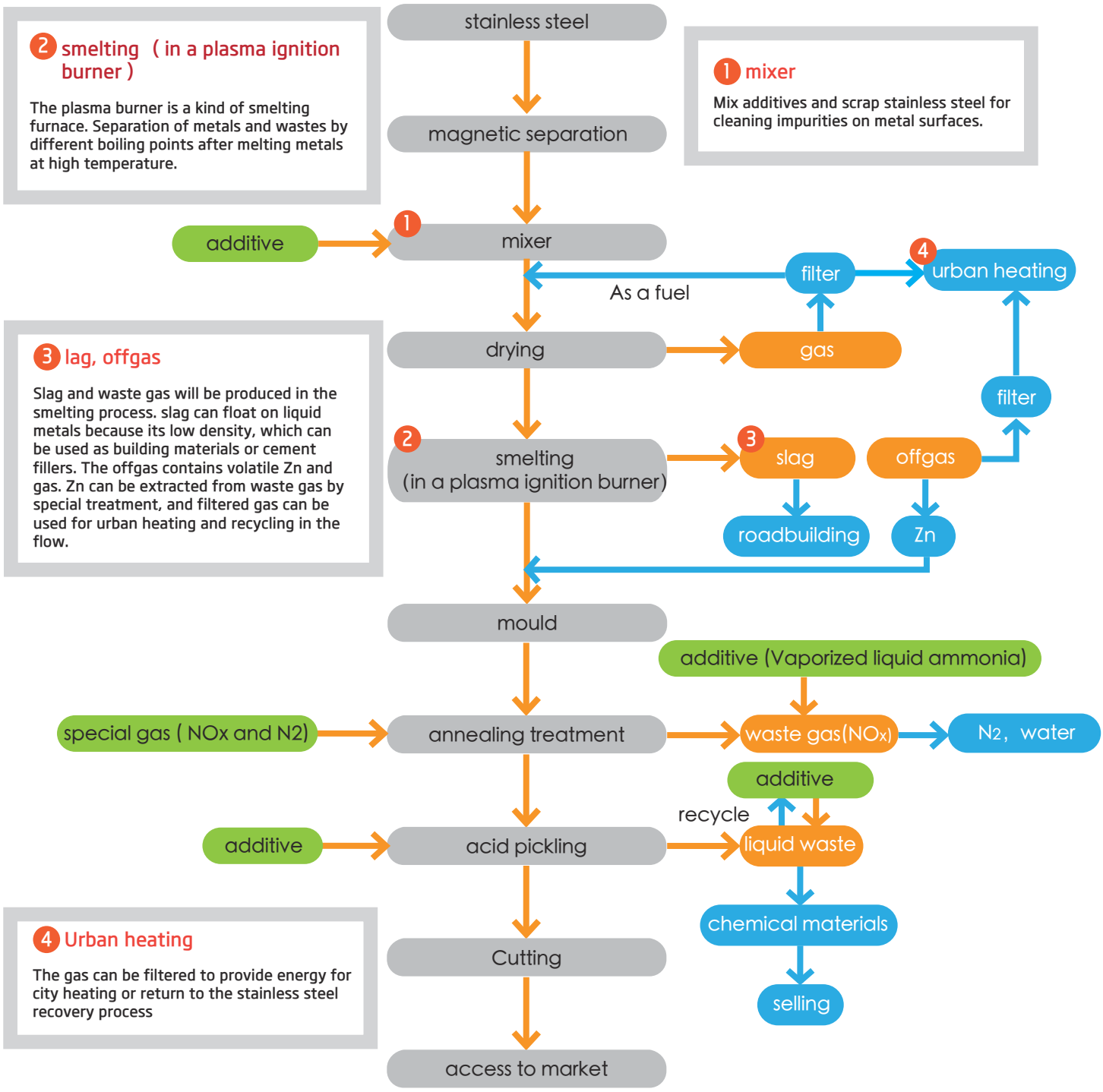
1.In the preheating stage, if the oil on the waste iron surface is not fully burned, a large amount of waste gas (hydrocarbon) will be produced, which will cause air pollution.

2. A lot of metal oxide dust and residue will be generated. Direct landfill will cause waste and pollution.

3. It will cause metal waste and harmful gas generation (including dioxins, etc.).

4. In the process of annealing and pickling, the waste discharged will pollute the environment.

The new flow of recycling stainless steel



The advantages in new flow of stainless steel

1.Plasma technology is characterized by small scale, short investment recovery period, recovery of valuable metals such as chromium, nickel and other special advantages.

2. In this process, all the discharges are treated, so that harmful substances are treated, reducing environmental pollution and saving resources.

3.The gas produced after smelting is treated not only to provide fuel for the smelting process, but also to provide excess heat for urban heating.

4.The decompression evaporation method can be used as a circulating treatment for acid washing emissions.

The using of recycled stainless steel

Type 304 stainless steel is usually used in bicycle industry. 304 stainless steel belongs to austenitic stainless steel. It has strong corrosion resistance characteristics.①

Introduction of stainless steel 304

304 stainless steel is a common stainless steel material, density of 7.93 g/cm 3, also known as 18/8 stainless steel industry. High temperature resistance 800, with good processing performance, high toughness characteristics, widely used in industrial and furniture decoration industry and food and medical industry.

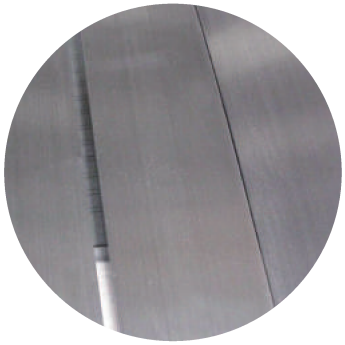
304 stainless steel is the most widely used Chromium-Nickel Stainless steel. As a widely used steel, it has good corrosion resistance, heat resistance, low temperature strength and mechanical properties. It is suitable for food processing, storage and transportation. It has good processability and weldability. Plate heat exchangers, corrugated tubes, household appliances (1, 2 types of tableware, cabinets, indoor pipelines, water heaters, boilers, bathtubs), automotive accessories (windshield wipers, mufflers, molded products), medical appliances, building materials, chemistry, food industry, agriculture, marine components, etc. 304 stainless steel is a national recognized food grade stainless steel. ②

The using of recycled stainless steel 304

Bike rack

tableware

cabinet



food industry

building materials

medical instrument

water heater

auto parts

Reference:
①https://wenku.baidu.com/view/2fd8a53c2af90242a895e5ed.html
②https://baike.baidu.com/item/304%E4%B8%8D%E9%94%88%E9%92%A2/4602319?fr=aladdin

Recycle of stainless steel

Current flow:

1. Magnetic separation
Magnetic separation is the most effective way to separate metals. It separates solid wastes by magnetic difference and non-uniform magnetic sound of various substances.

2.Cleaning
Use various chemical solvents or thermal surfactants to remove oil, rust and sediment on the surface of iron parts.

3.Preheat
The stainless steel is heated in advance before melting, so that the water and oil on the surface of the stainless steel evaporate to avoid becoming impurities after melting. In many Chinese stainless steel factories, the method of preheating waste stainless steel is to use flame to directly bake the waste iron, burn away the moisture and grease, and then put it into the furnace. This method can lead to incomplete combustion of oils and the production of large amounts of hydrocarbons, resulting in air pollution [1].

4.Smelting
Use an electric furnace to melt stainless steel, which produces waste in the process. The waste usually include dust, residue, oxide, offgas [2].

5.Mould
After melting, the molten steel is cast into the required semi finished product.

6. Annealing treatment
annealing treatment is a process for cooling high-temperature stainless steel. It can improve the quality of stainless steel and enhance the plasticity of stainless steel. Some special gas (NOx and N2) need to be added in the annealing treatment, and waste NOx needs to be discharged at the same time. Nitrogen oxides are toxic to varying degrees [3].
7. Acid pickling
acid pickling is a way to clean metal surfaces, which can remove oxides from steel surfaces and improve the quality of stainless steel. In acid pickling process, it is necessary to add some additive (such as electrolysis Na2SO4, HNO3+HF), and it can produce some waste liquid (such as waste nitric acid, waste mixed acid, waste Na2SO4, waste NOx, etc.) [4].

8. Cutting
The semi stainless steel is cut into a specific shape [5].

Problems analysis in current flow of recycling stainless steel:

1.In the preheating stage, if the oil on the waste iron surface is not fully burned, a large amount of waste gas (hydrocarbon) will be produced, which will cause air pollution.

2. A lot of metal oxide dust and residue will be generated. Direct landfill will cause waste and pollution.

3. It will cause metal waste and harmful gas generation (including dioxins, etc.).

4. In the process of annealing and pickling, the waste discharged will pollute the environment.

Reference:

[1] https://www.cqsq.com/hqxx/2018/0412/25920915.html
[2] An overview for the utilization of wastes from stainless steel industries. Zhang Huaiwei, Hong Xin, Crown Copyright © 2011 Published by Elsevier B.V. All rights reserved.
[3][4] https://wenku.baidu.com/view/2d9b95f810661ed9ac51f381.html
[5] https://cougartron.com/blog/6-steps-manufacturing-process-stainless-steel-product/

Proposal flow:

1. Magnetic separation
Magnetic separation is the most effective way to separate metals. It separates solid wastes by magnetic difference and non-uniform magnetic sound of various substances.

2. Mixer
Mix dust removal additives and scrap stainless steel for cleaning impurities on metal surfaces.

3. Drying
Dry the metal surface to avoid water residue affecting the melting quality.The drying process produces gas. The gas can be filtered to provide energy for city heating or return to the stainless steel recovery process

4. Smelting (in a plasma ignition burner)
The plasma burner is a kind of smelting furnace. Separation of metals and wastes by different boiling points after melting metals at high temperature.
Slag and waste gas will be produced in the smelting process. slag can float on liquid metals because its low density, which can be used as building materials or cement fillers. The offgas contains volatile Zn and gas. Zn can be extracted from waste gas by special treatment, and filtered gas can be used for urban heating and recycling in the flow [6].
5. Mould
After melting, the molten steel is cast into the required semi finished product.

6. Annealing treatment
Annealing is a process for cooling high temperature stainless steel. Can improve the quality of stainless steel, improve the plasticity of stainless steel. Special gases (NOx and N2) are added to the annealing process, and NOx waste is discharged at the same time. In the waste gas into the additives (Vaporized liquid ammonia), N2 and water, which are safe and no pollution. N2 can be sold.

7. Acid pickling
acid pickling is a way to clean metal surfaces, which can remove oxides from steel surfaces and improve the quality of stainless steel. In acid pickling process, it is necessary to add some additive (such as electrolysis Na2SO4, HNO3+HF), and it can produce some waste liquid (such as waste nitric acid, waste mixed acid, waste Na2SO4, waste NOx, etc.). Additive (H2SO4) can add to the waste liquid with a method calls "vacuum evaporation" to produce additive and chemicalmaterials (Fe2SO4). Among them, additives can be recycled and chemical materials can be sold [7].

8. Cutting
The semi stainless steel is cut into a specific shape.

The advantages in new flow of stainless steel:

1.Plasma technology is characterized by small scale, short investment recovery period, recovery of valuable metals such as chromium, nickel and other special advantages.

2. In this process, all the discharges are treated, so that harmful substances are treated, reducing environmental pollution and saving resources.

3.The gas produced after smelting is treated not only to provide fuel for the smelting process, but also to provide excess heat for urban heating.

4.The decompression evaporation method can be used as a circulating treatment for acid washing emissions.

Reference:

[6] Recovery of precious metals from stainless steel production and processing waste，Fu Xiao, 2011.07.05
[7] https://wenku.baidu.com/view/2d9b95f810661ed9ac51f381.html

The using of recycled stainless steel

Type 304 stainless steel is usually used in bicycle industry. 304 stainless steel belongs to austenitic stainless steel. It has strong corrosion resistance characteristics.①

Introduction of stainless steel 304：

304 stainless steel is a common stainless steel material, with good processing performance, high toughness characteristics, widely used in industrial and furniture decoration industry and food and medical industry.

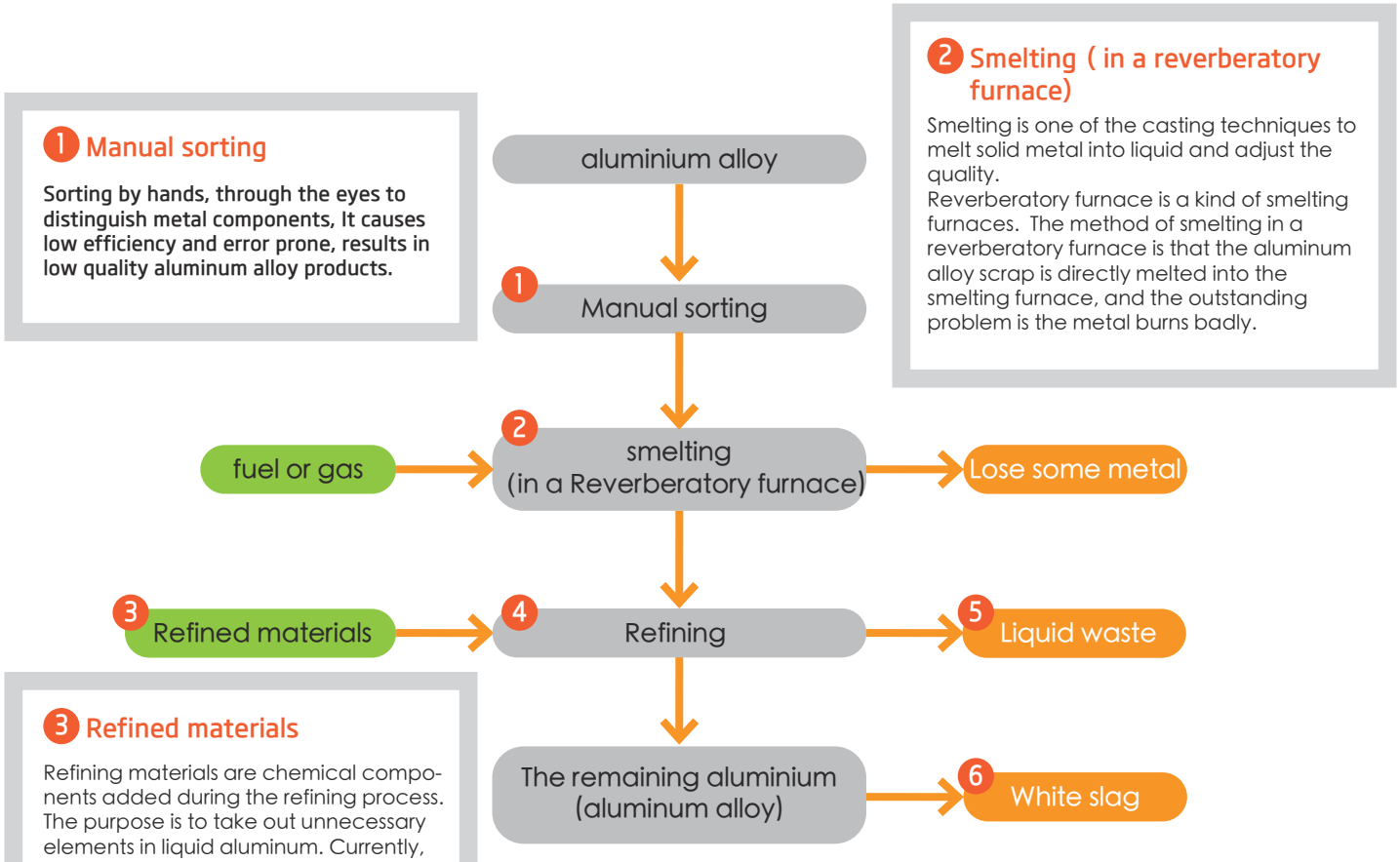
The using of stainless steel 304：

304 stainless steel is the most widely used Chromium-Nickel Stainless steel. As a widely used steel, it has good corrosion resistance, heat resistance, low temperature strength and mechanical properties. It is suitable for food processing, storage and transportation. It has good processability and weldability. Plate heat exchangers, corrugated tubes, household appliances (1, 2 types of tableware, cabinets, indoor pipelines, water heaters, boilers, bathtubs), automotive accessories (windshield wipers, mufflers, molded products), medical appliances, building materials, chemistry, food industry, agriculture, marine components, etc. 304 stainless steel is a national recognized food grade stainless steel.②

Reference:
①https://wenku.baidu.com/view/2fd8a53c2af90242a895e5ed.html
②https://baike.baidu.com/item/304%E4%B8%8D%E9%94%88%E9%92%A2/4602319?fr=aladdin

3.1.7 The comparison of the current flow and proposal flow in recycling aluminium alloy

The old flow of recycling aluminium alloy



1 Manual sorting

Sorting by hands, through the eyes to distinguish metal components, It causes low efficiency and error prone, results in low quality aluminum alloy products.

2 Smelting (in a reverberatory furnace)

Smelting is one of the casting techniques to melt solid metal into liquid and adjust the quality.
Reverberatory furnace is a kind of smelting furnaces. The method of smelting in a reverberatory furnace is that the aluminum alloy scrap is directly melted into the smelting furnace, and the outstanding problem is the metal burns badly.

3 Refined materials

Refining materials are chemical components added during the refining process. The purpose is to take out unnecessary elements in liquid aluminum. Currently, common refining materials in China include: NaCl， NaF, KCl, Na3AlF6, etc.

4 Refining

Refining is a process of removing gases, impurities and harmful substances from liquid aluminum. Refining can improve the purity of metals. High quality liquid aluminum can be obtained by refining.

5 Liquid waste

Out put of refining, After the chemical reaction between the refining material and the impurity of liquid aluminum produces waste liquid, the waste liquid which cause environmental pollution include: AlCl3, HCl, Cl, etc.

6 White slag

White slag is a kind of waste from the recovery of aluminum alloy, including aluminum oxide and some harmful substances.

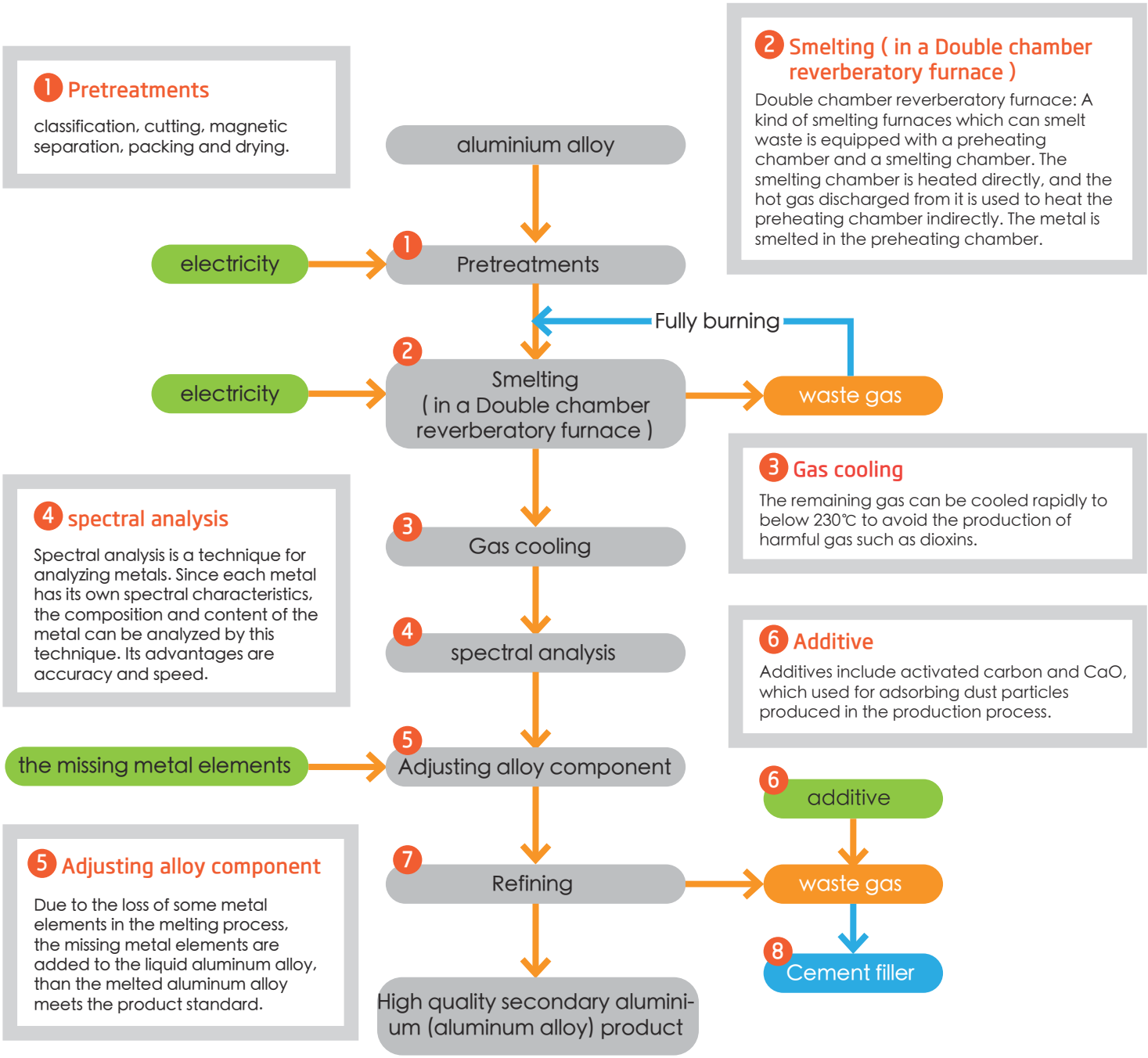
Problems analysis in current flow of recycling aluminium

1.The traditional aluminum alloy recycling method uses manual sorting, which is inefficient and time-consuming.

2. While heating and melting aluminum directly by fire, the cost of production is reduced, but in the process of smelting, the burning loss of aluminum is very large, especially when smelted the scrap aluminum, such as some thin or aluminum scrap, and the efficiency of recovery is very low.

3.The refining process of aluminum melt also produces a lot of poisonous gases, causing great harm to people and the environment.

The new flow of recycling aluminium alloy



1 Pretreatments

classification, cutting, magnetic separation, packing and drying.

2 Smelting (in a Double chamber reverberatory furnace)

Double chamber reverberatory furnace: A kind of smelting furnaces which can smelt waste is equipped with a preheating chamber and a smelting chamber. The smelting chamber is heated directly, and the hot gas discharged from it is used to heat the preheating chamber indirectly. The metal is smelted in the preheating chamber.

3 Gas cooling

The remaining gas can be cooled rapidly to below 230℃ to avoid the production of harmful gas such as dioxins.

4 spectral analysis

Spectral analysis is a technique for analyzing metals. Since each metal has its own spectral characteristics, the composition and content of the metal can be analyzed by this technique. Its advantages are accuracy and speed.

5 Adjusting alloy component

Due to the loss of some metal elements in the melting process, the missing metal elements are added to the liquid aluminum alloy, than the melted aluminum alloy meets the product standard.

6 Additive

Additives include activated carbon and CaO, which used for adsorbing dust particles produced in the production process.

7 Refining

Removal of gases, inclusions and harmful elements from molten liquid metals is a process and operation procedure to obtain excellent aluminum liquid.
Nothing needs to be added to the new process.

8 Cement filler

Cement filler can use as building materials.
Accoding to the “Residues from aluminium dross recycling in cement”, the waste of secondary aluminium production has found use as a filler in asphalt and concrete.

The advantages in proposal flow of recycling aluminium

1.Magnetic sorting improves the efficiency of pretreatment, avoids the classification error, and improves the quality of secondary aluminum alloy.

2. Double chamber reverberatory furnace reduces the energy consumption in the proposal flow, improves the recovery ratio and quality of aluminum alloy, and reduces the harmful gases and pollutants generated in the recovery process.

3.Waste can be recycled into concrete materials to reduce pollution and waste

The using of recycled aluminium alloy

The aluminum alloy frame used for the aluminum alloy frame is 6061. Because all the debris in the production process comes from the frame, the discarded aluminum alloy in the production process is 6061.①

Introduction of aluminium alloy 6061

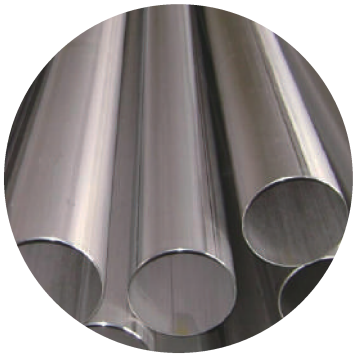
6061 is a precipitation-hardened aluminum alloy, containing magnesium and silicon as its major alloying elements. Originally called "Alloy 61S", it was developed in 1935. It has good mechanical properties, exhibits good weldability, and is very commonly extruded (second in popularity only to 6063). It is one of the most common alloys of aluminum for general-purpose use.②

The using of recycled aluminium alloy

Bike rack

Medicine packaging

flashlights

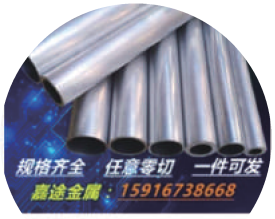


Appearance of electronic products

aluminum cans

aluminum packages

food container



③

selling price: 645yuan/m³

Reference:
①http://www.sohu.com/a/193966268_716522
②https://en.wikipedia.org/wiki/6061_aluminium_alloy
③https://item.taobao.com/item.htm?sp-m=a230r.1.14.44.404029e7QinNbC&id=546785866448&ns=1&abbucket=16#detail

Recycle of Aluminum Alloy

Current flow:

1.Manual sorting:
Workers Sort metals by hands, through the eyes to distinguish metal components, It causes low efficiency and error prone, results in low quality aluminum alloy products.

2.Smelting:
Smelting is one of the casting techniques to melt solid metal into liquid and adjust the quality.
most of the regenerative aluminum smelting equipment in China is an ordinary reverberatory furnace (fuel or gas).This device uses fire to smelt aluminum directly. The cost of production is reduced, however the burning loss of aluminum become large during the smelting process, especially when smleting materials such as thin or aluminum scraps, besides the recovery efficiency is very low.

3.Refining:
Refining is a process of removing gases, impurities and harmful substances from liquid aluminum. Refining can improve the purity of metals. High quality liquid aluminum can be obtained by refining.
Refining materials need to be added in the refining process. At present, most of the refining materials in China are NaCl, NaF, KCl and Na3AlF6, and some are Cl2 or C2Cl6.Although the effect of refining waste aluminum alloy with Cl-containing ingredients is better, the chemical components such as AlCl3, HCl and Cl produced by the refining process will cause serious damage to human body, environment and equipment [1].

4.waste
After the above process, the recycled aluminum produced is of low quality and much waste. And it produces a lot of waste slag, which contains a lot of unrecycled aluminum, oxides and some harmful substances.

Reference:
[1] Huang Moyijie, Ren Xianwei., Discussion on recycling and utilization technology of recycled aluminum [J]. Aluminum Processing, 2015 , 51-57.

Problems analysis in current flow of recycling aluminium alloy:

1.The traditional aluminum alloy recycling method uses manual sorting, which is inefficient and time-consuming.

2. While heating and melting aluminum directly by fire, the cost of production is reduced, but in the process of smelting, the burning loss of aluminum is very large, especially when smelted the scrap aluminum, such as some thin or aluminum scrap, and the efficiency of recovery is very low.

3.The refining process of aluminum melt also produces a lot of poisonous gases, causing great harm to people and the environment.

Proposal flow:

1. Pretreatments
Including classification (gravity separation and magnetic separation), disassembly, cutting, magnetic separation, packing and drying. The aim of pretreatment is to remove explosives, iron components and moisture [1].
2. Smelting
Double chamber reverberatory furnace: A kind of smelting furnaces which can smelt waste is equipped with a preheating chamber and a smelting chamber. he smelting chamber is heated directly, and the hot gas discharged from the smelting chamber can heat the preheating chamber indirectly. This gas flows into the preheating chamber through the holes of the baffle, and its flow rate is strictly controlled so as to produce the required preheating temperature and cause partial combustion and melting of contaminants (paint, oil, water, etc.[2]) on the metal surface. The waste gas of aluminium alloy scrap is sent from the preheating chamber to the smelting chamber through a circulating fan for secondary combustion treatment. The large volume of smelting chamber gives the waste gas enough time to fully burn off the combustible and harmful substances in the waste gas [3]. The smelting furnace uses a bottom permanent magnet agitator. The flow of aluminum liquid produced by the agitator can avoid overheat on surface of aluminum liquid, thus can reduce the formation of alumina, improve the effect of heat and mass transfer, average temperature and alloy component of aluminum liquid rapidly, and improve the production efficiency.

3.Gas cooling
The remaining gas can be cooled rapidly to below 230℃ to avoid the production of harmful gas such as dioxins.

4. Adjustingalloy component
Sampling for spectral analysis. Alloying elements will be added to liquid aluminum alloy before refining due to the loss of alloy elements during smelting. According to the different grades of alloy, different elements will be added to make the smelted aluminum alloy meet the product standard.

5.Refining
Removal of gases, impurities and harmful elements from molten molten metal is a process for obtaining high-quality aluminum liquid.
There are many refining methods for aluminium alloys. According to their working principle, they can be divided into two basic types: adsorption refining and non-adsorption refining. The adsorption process is used in the proposal flow. There is no need to add chemical materials in the refining process. The waste gas will be produced after refining. The mixture of activated carbon and lime can be added to the waste gas. The additive reacts with incombustible chemical composition to absorb the waste gas components. The dust particles in the waste gas are filtered through the dust collector [4].

6. Treatment of waste
Waste from chemical reactions of additives (quicklime and CaO) used in the proposal flow with waste gas can be used as cement fillers and building materials [5].

The advantages in new flow of stainless steel:

1.Magnetic sorting improves the efficiency of pretreatment, avoids the classification error, and improves the quality of secondary aluminum alloy.

2. Double chamber reverberatory furnace reduces the energy consumption in the proposal flow, improves the recovery ratio and quality of aluminum alloy, and reduces the harmful gases and pollutants generated in the recovery process.

3.Waste can be recycled into concrete materials to reduce pollution and waste

Reference:

[1] Gao Anjiang,QuXinlei. Study on technology and technology of recycling of scrap aluminum [J].Renewable Resources and Circular Economy, 2014, 7(2):35-36.
[2] Huang Moyijie, Ren Xianwei. Discussion on recycling and utilization technology of recycled aluminum [J]. Aluminum Processing, 2015 (6): 51-57.
[3] Liu Shaoyu. Recycling and reuse technology of waste aluminum alloy [J]. Nonferrous Metal Processing, 2011, 40 (4): 1-4.
[4] https://en.wikipedia.org/wiki/Aluminium_recycling
[5] Residues from aluminiumdrossrecycling in cement, DrEvaggeliaPetavratzi, Scott Wilson (formerly of the University of Leeds), 2007.11
[6] https://patents.google.com/patent/CN101941821B/zh

The using of recycled aluminium alloy

The aluminum alloy frame used for the aluminum alloy frame is 6061. Because all the debris in the production process comes from the frame, the discarded aluminum alloy in the production process is 6061[1].

Introduction of aluminium alloy 6061:

6061 is a precipitation-hardened aluminum alloy, containing magnesium and silicon as its major alloying elements. Originally called "Alloy 61S", it was developed in 1935. It has good mechanical properties, exhibits good weldability, and is very commonly extruded (second in popularity only to 6063). It is one of the most common alloys of aluminum for general-purpose use.

The using of recycled aluminium alloy

6061 aluminum alloy is widely used in decoration, packaging, construction, transportation, electronics, aviation, aerospace, weapons and other industries. 1. Aerospace. 2. Transportation. 3. Packaging. Widely used in beverage, food, cosmetics, drugs, cigarettes, industrial products and other packaging. 4. Printing. 5. Architectural decoration. Widely used in building frames, doors and Windows, ceiling, decorative surface and so on. 6. Electronic appliances. Used in conductor, electrical components, refrigerator, air conditioning, cable and other fields [2].

Reference:

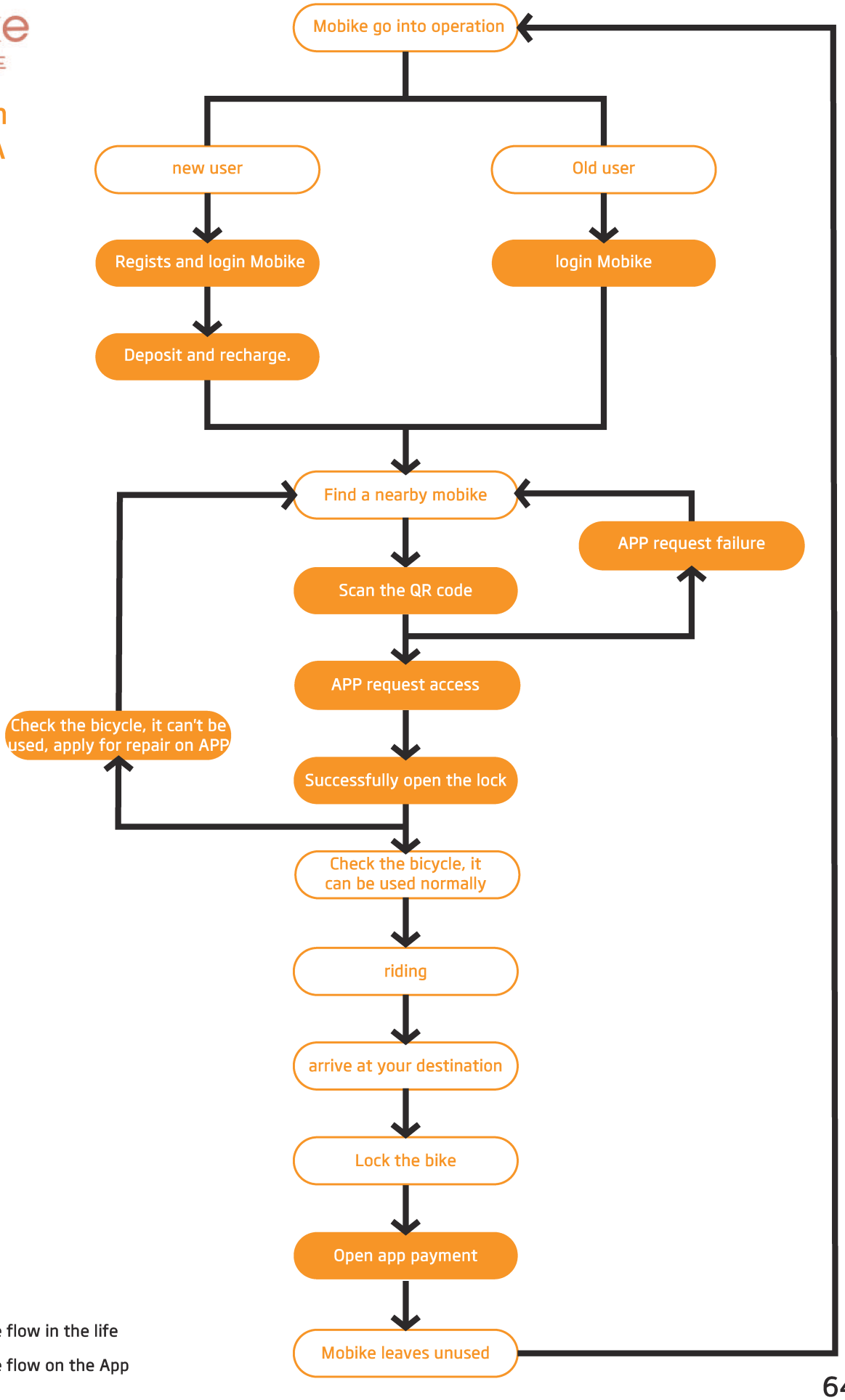
[1] http://www.sohu.com/a/193966268_716522
[2] https://en.wikipedia.org/wiki/6061_aluminium_alloy

3.2 The current flow of operation

3.2.1The current flow of operation of OFO, Mobike and Hellobike

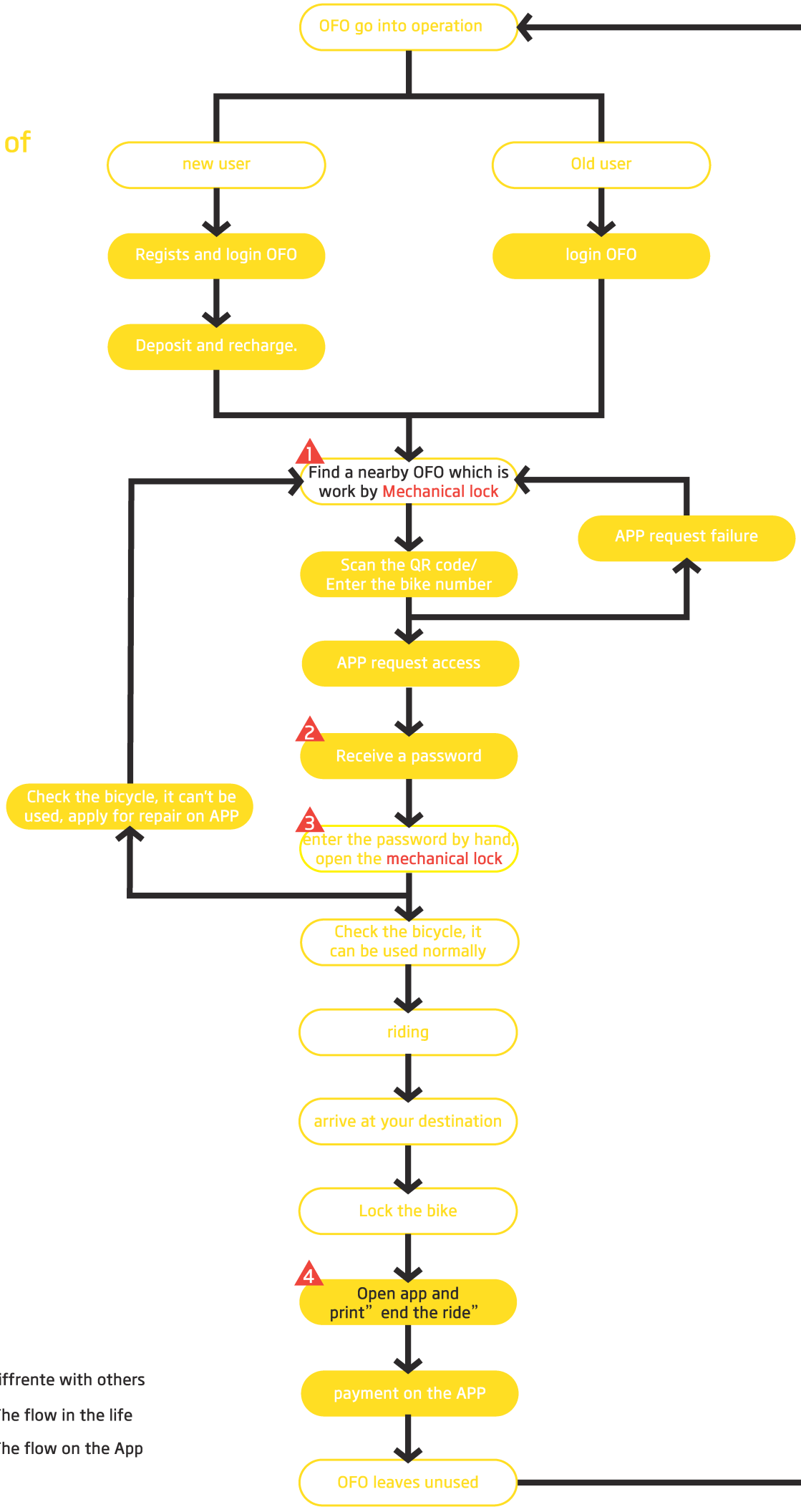
mobike 摩拜单车

Operation pattern A



ofo
共享单车

Operation of OFO

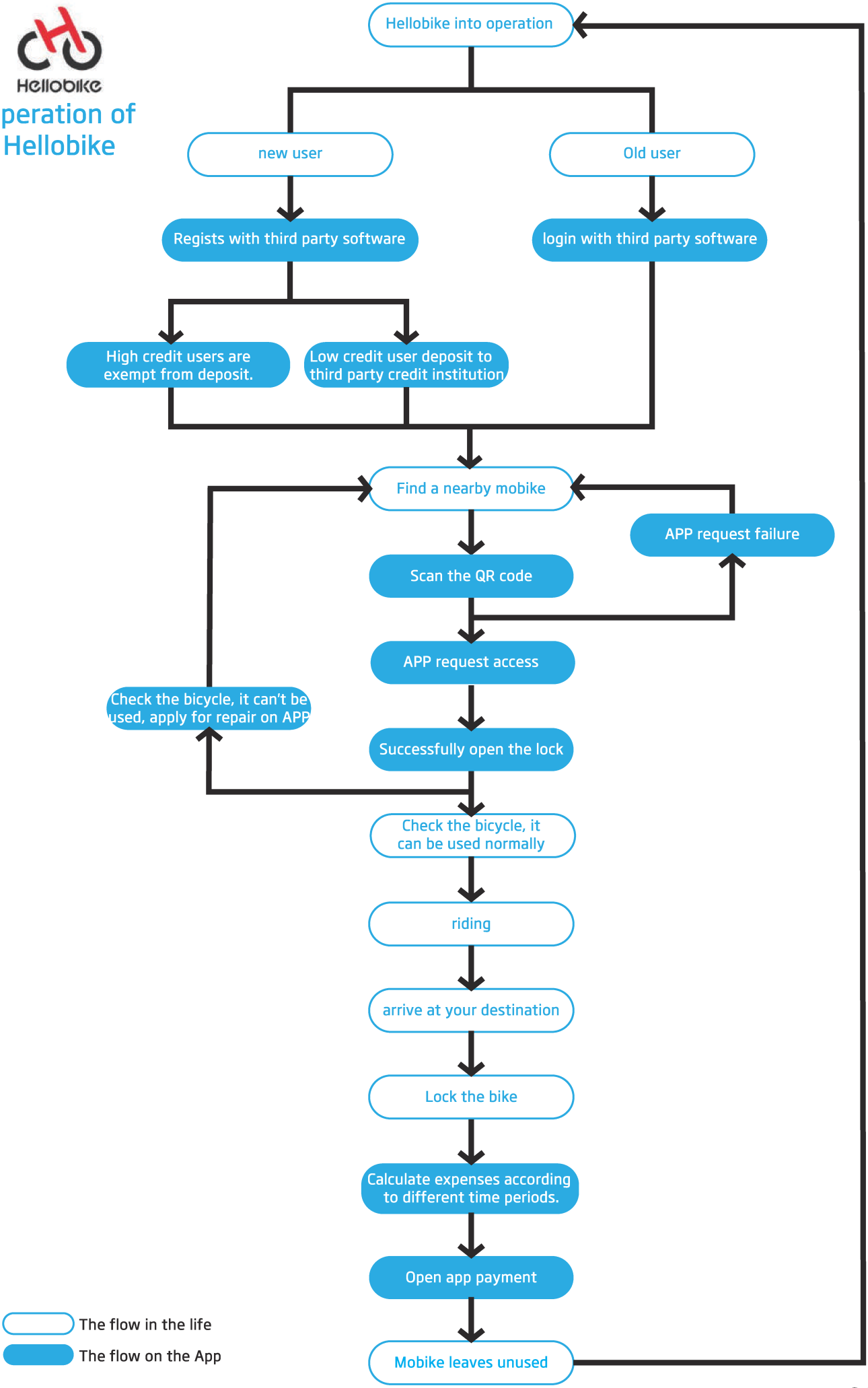


The diffrente with others

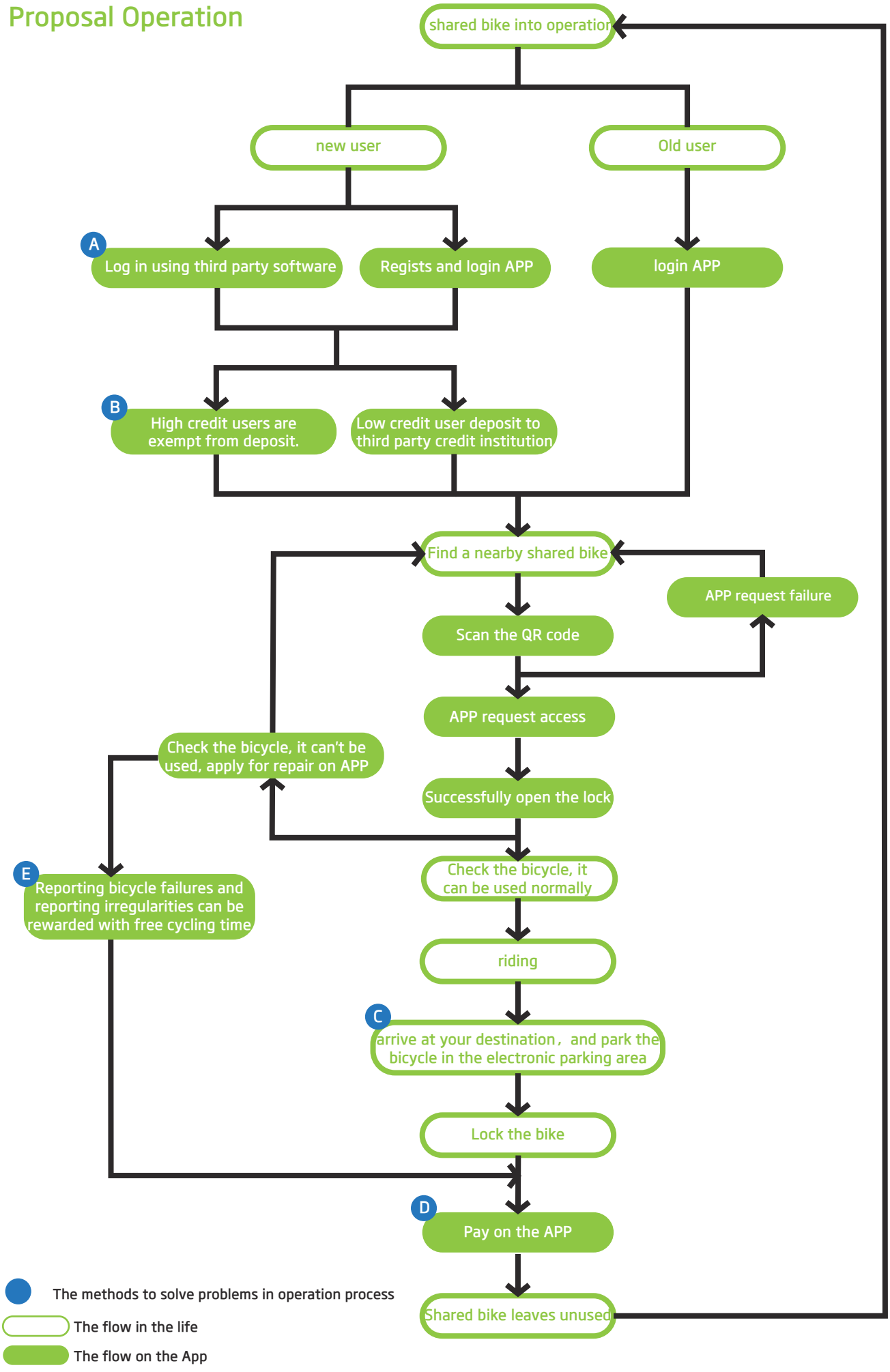
The flow in the life

The flow on the App

Operation of Hellobike



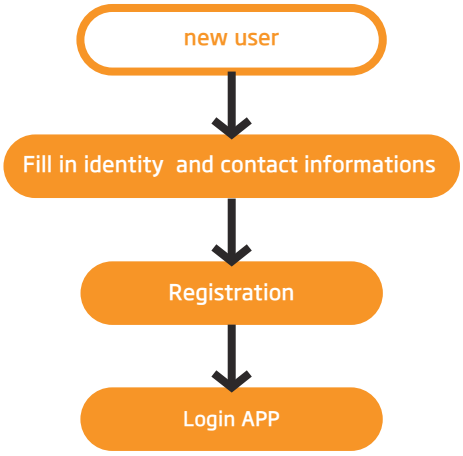
3.2.2 The analysis of proposal flow of operation



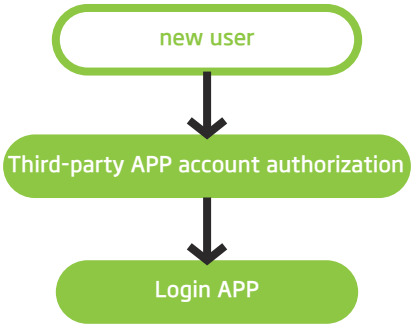
Details analysis of methods to solve problems in operation process

A Registration and login

Current flow



proposal flow



Proposal flow advantages:

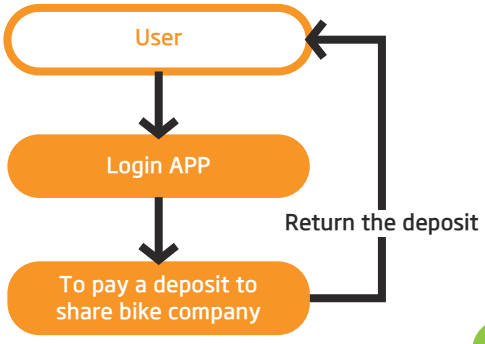
1. Users do not need to fill in personal information again, and use the authorization of the third party software to prevent information leakage.

2. Simplify registration and login steps, one click login, simple and convenient.

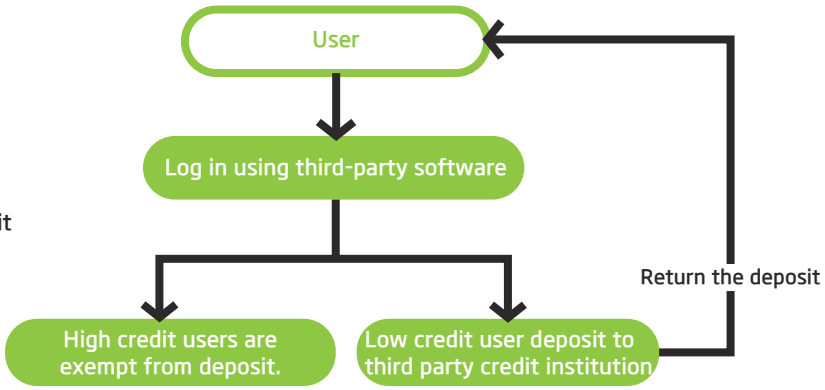
3. Increase cooperation and linkage among enterprises and create economic benefits.

B Deposit

Current flow



proposal flow



Proposal flow advantages:

1. According to the user's credit provided by the credit institutions, the users with high credit are exempted from deposit and reduce the users with high credit extra expenses.

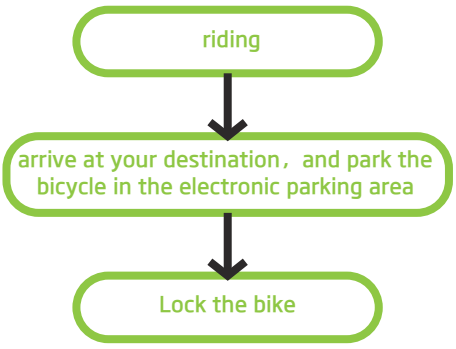
2. the deposit is kept by third party credit institutions, so as to avoid shared bicycle company divert the user's deposit.

3. Return the deposit to the user by the third-party credit institution when the deposit is returned. Avoid the shared bicycle company delaying the time of refunding the deposit to users or refusing to refund the deposit to users.

C Registration and login

Current flow

proposal flow



Proposal flow advantages:

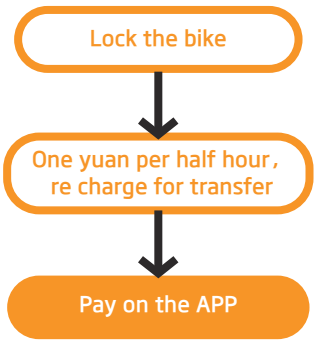
1. Parking bicycles in electronic parking area can avoid traffic congestion caused by random parking of bicycles and relieve the pressure of excessive occupancy of urban space.

2. It is convenient for the manager to manage and repair bicycles.

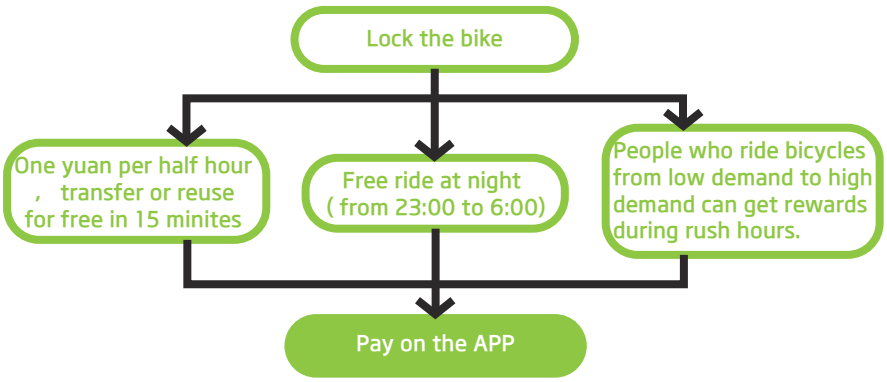
3. Increase cooperation and linkage among enterprises and create economic benefits.

D Price

Current flow



Proposal flow



Proposal flow advantages:

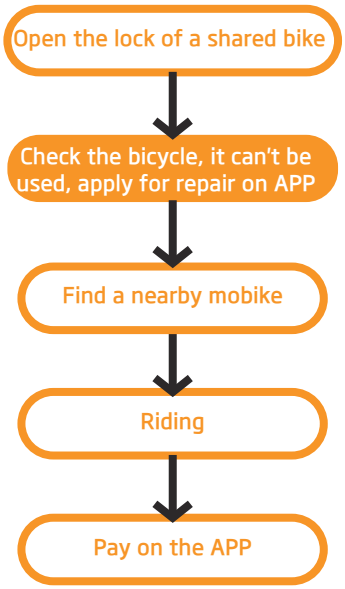
1. Within 15 minutes, free change or re lock, reduce extra expenses for short distance parking lots.

2. Free cycling at night can improve the utilization rate of shared bicycles at night and reduce the expenditure of people riding at night.

3. Usually electronic parking areas are monitored to reduce vandalism, theft and illegal occupation of shared bikes.

E tip-off

Current flow



proposal flow

Proposal flow advantages:

1. Submit repair feedback to enable administrators to repair the problems of shared bicycles in time.

2. Reporting can enable managers to find and deal with damaged or stolen shared bikes quickly, investigate the saboteurs and thieves' responsibilities according to law, so that shared bike companies can get the compensations.

3. Rewards can improve the enthusiasm of whistleblowers, establish social morality and maintain legal order.

The analysis of problem in the process of operation

We need to salve 5 problems in current operation flow:
The problems in current operation flow:

Problem A:
User registration app starts using shared bicycles, which results in personal information security. How can users protect their personal information when APP is registered?

The solutions in proposal flow A:
Using the third-party software

The description of proposal flow A:
For this problem, we recommend that users login with WeChat or Alipay ID (similar to electronic banking login). WeChat and Alipay have a large number of users in China with popular support (WeChat has one billion users[1]and Alipay has 780 million users[2]). Login through these accounts can avoid re registration, which is faster and more convenient. WeChat and Alipay belong to large companies, whose website has high security assurance. They can ensure users' personal information security. WeChat and Alipay have complete credit scoring systems (described in the next section), and the sharing of credit notes also strengthens the partnership between the two companies. This cooperation is a good chance to promote the these two production. If users are willing to use their personal information to register the shared bike apps, they can ensure personal information security through relevant laws. The Cyber Security Law of the People's Republic of China came into effect on June 1st, 2017, which is the first network security law in China. The protection of personal information is an important part of it. Article 40 of Chapter IV of the Law stipulates that network operators shall keep strictly the user' s information they collect, and establish and improve the system of personal information protection. Article 42 stipulates that network operators shall not reveal, distort or destroy the personal information they collect, and shall not provide personal information to others without the consent of the person being collected. Network operators shall take technical and other necessary measures to ensure the personal information security they collect and to prevent the leakage, damage and loss of personal information. In the event of leakage, damage or loss of personal information occurring or possibly occurring, remedial measures shall be taken immediately. Users shall be informed in time. The operator should report the situation to the competent authorities.[3] These mandatory legal ensure the security of personal information on the network, and become a powerful barrier for users.

Proposal flow advantages:
1. Users do not need to fill in personal information again, and use the authorization of the third party softwareto prevent information leakage.
2. Simplify registration and login steps, one click login, simple and convenient.

3. Increase cooperation and linkage among enterprises and create economic benefits.

[1] http://www.sohu.com/a/136382735_184641
[2] http://tech.sina.com.cn/i/2018-05-04/doc-ifzfkmth8960261.shtml
[3] http://www.npc.gov.cn/npc/xinwen/2016-11/07/con tent_2001605.htm

Problem B:

A deposit must be paid if a bicycle is used. Is the operator misappropriating the user deposit? Is the collection and management of deposits conformed to the legal? For users, whether the deposit can be returned on time, and whether the rights and interests of users can be guaranteed.

The solutions in proposal flow B:

Using credit scoring system instead of deposit:

The description of proposal flow B:

In addition to Hellobike, both OFO and Mobike need users to pay a deposit before they use bicycles. However, recently, China lacks corresponding regulators. The company Mobike was once exposed that it diverted users' deposits to buy financial products, causing users panic. The deposit of Mobike needs users to wait 2-7 days before it can be refunded after the user makes the application. In this period the user can't use the bicycle causing inconvenience. At present, the definition of shared bike deposit is not clear. By referring to relevant documents, it is generally considered that a deposit refers to a certain amount of money delivered by one party to the other party, which ensure that his actions will not harm the interests of the other side. Once the damage occurs, the money can be directly used to compensate. The property of shared bike deposits is argumentative and it is not yet clear. Traditionally, the deposit has one-to-one relationship with the leased goods, while a shared bike means that a single bicycle corresponds to multiple users. It means that a lease item corresponds to multiple deposits. Therefore, the deposit of shared bike is not a real 'deposit'. If the funds are diverted, there is the suspicion of illegal fund-raising. But the deposit for shared bike has no clear provisions, it belongs to the legal "grey zone". At present, the revenue of shared bike mainly comes from the cost of using bicycle. The cost of using bicycles is mostly between 1 yuan (0.12€) and 2 yuan, which is extremely low. In the case of OFO, the cost of each bicycle is 350 yuan for a deposit of 99 yuan. We calculate at the lowest scrap rate of 20% a year and nearly 30,000 bikes are scrapped a year. That mean the cost of wear and tear of OFO in Nanjing is 10,500,000 yuan per year. Even if a certain deposit is received, it is also faced with the situation of artificial destruction and private ownership. Facing the huge loss caused by high consumption, the profit of shared bike mainly depends on investment. Once the capital chain cannot be supplied, it is likely to divert the deposit. Faced with the shortcomings of this deposit model, the deposit-free model adopted by Hellobike is more reasonable and can be used for reference. Hellobike's credit scoring system is divided into two parts:

1. If users have more than 650 credit scores in Alipay, they can use a bicycle without a deposit after registration. Alipay's credit scoring system is relatively sound. Alipay's credit scoring system consists of five factors: identity, behavioral preferences, interpersonal relationships, credit history, and honour an agreement. Identity refers to identity information, education background, and consumption records. Behavioral preferences refer to consumption records and consumption capacity. Interpersonal

relationship is the credit record about your friend. Credit history is the credit record of the bank. The record is tied by Alipay. Honour an agreement is to measure credit score through other network entries when it is impossible to obtain relevant information from Alipay. These five factors are three-dimensional and comprehensive to measure user's credit situation. It has a certain value of reference.

2. if the user does not have Alipay credit score or its credit score is insufficient, the system will give users 100 points at registration. If the user violated traffic regulations, the system deducts 50 credit points; when the credit score is lower than 80, the single price of the riding will be raised from 1 yuan / half hour to 100 yuan / half hour; when the credit score is 0, the user's account will be permanently frozen.

The deposit mode will not be cancelled in a short time until the deposit-free mode is put into effect. For OFO and Mobike, here are some suggestions: we suggested that the two shared bike company cooperate with Alipay with credit scores record. When the credit score drops to a certain value, a deposit must be paid. In order to ensure that the deposit is not diverted, the deposit should be kept with the third-party credit institution. Of course, the refund of the deposit should also come from the third-party credit institutions. For irregularities such as: irregular parking bicycles. Violators should be fined. If the user refuses to pay the fine before the deadline, the fine will be deducted from the deposit. If irregularities lead to the low credit score, the account is locked until the fine is paid.

In short, the existing problems of deposit refund and misappropriation are mainly occasioned by imperfect laws, so the relevant departments should legislate as soon as possible. If the government improve the relevant laws and regulations, shared bike could keep healthy development.

Proposal flow advantages:

1. According to the user's credit provided by the credit institutions, the users with high credit are exempted from deposit and reduce the users with high credit extra expenses.
2. The deposit is kept by third party credit institutions, so as to avoid shared bicycle company divert the user's deposit.
3. Return the deposit to the user by the third-party credit institution when the deposit is returned. Avoid the shared bicycle company delaying the time of refunding the deposit to users or refusing to refund the deposit to users.

[1] http://www.woshipm.com/data-analysis/462978.html
[2] http://news.163.com/17/0516/11/CKI9NHV1000187VG.html

Problem C:

Public space also has legal rights and interests (public resources privilege). Whether the profit - making operator should submit the cost of public space occupation and management to the city, obey the arrangement of the city manager, conform to the planning of the city management. Thus it relieves the pressure of urban public space. At the same time, the distribution of the number of bikes is not reasonable: the high frequency area often has the users can not rent a bike, and some areas with low frequency are idled. After investigation, we should take corresponding measures to improve this problem. The user is not standardized to park the bike, which is inconvenient for the use again.

The solutions in proposal flow C:

Using Intelligent Parking Stations (dockless parking area) and using the monitoring system

The description of proposal flow C:

At present, there is no corresponding regulations on public space management in Nanjing to regulate the management of urban public space. According to the Administrative License Law of the People's Republic of China concessions are divided into three categories: natural resources concessions, public resources concessions and government concessions. For shared bikes, urban space resources include parking areas nearby street and cycle path. Urban space resources belong to public resources, so it has the public resources concessions[1]. Point at many public spaces are occupied, which is caused by a large amount of shared bike putting in the market. It is suggested that the government could collect fees. The charge belongs to administrative fees and it is non-profit. The fee can be distributed according to the quantity of shared bike putting in the market by shared bike companies, and those who put in more should pay more. This not only alleviates the problem of urban space congestion, but also helps to improve the efficiency of the use of shared bikes.

Although Mobike and OFO are similar to Hellobike for dockless parking area. But the two companies have no monitoring function in the dockless parking area, which cannot prevent artificial damage and occupancy of bicycles.. Hellobike launched the "virtual parking area" on March 1, 2017. There are no docks and only a square with white lines. Parking is effective in this area, and there is no need to find a dock to park the bike. This can alleviate the random parking caused by no parking area. At the same time, Hellobike's Intelligent Parking Stations integrates GPS positioning module and Internet of Things chip. This system can obtain the number and state of bicycles in the area, geographical fence, riding track etc. This intelligent system not only solves the problem of uneven distribution of bicycles in some areas, but also can guide the user to park in a civilized way. Users cannot park the bicycle in the residential area, underground parking area etc. and other non-shared bike parking areas. This effectively prevents the private occupancy of public bicycles. "dockless parking area" and intelligent parking system are relatively advanced technology, providing a reference for ofo and Mobike. Here we further propose that a monitor be set up

near the " dockless parking area " to prevent the artificial damage of bicycles and be held responsible for the vandals. At the same time, the monitoring system is also convenient for operators to check and manage the bicycles.

Proposal flow advantages:

1. Parking bicycles in electronic parking area can avoid traffic congestion caused by random parking of bicyclesand relieve the pressure of excessive occupancy of urban space.
2. It is convenient for the manager to manage and repair bicycles.
3. Increase cooperation and linkage among enterprises and create economic benefits.

[1] http://m.liuxiaoer.com/sj/4132.html

Problem D:

The charge problem that users care about in the process. According to the information on internet, many users are not satisfied with the existing billing system: the current fee scale is sectionalized: 1 yuan per 30 minutes per bike, no ceiling, and the second times unlocking the bike recharged. This is not very cost-efficient for people who ride many times in a short time. How to improve the charging system to make it more reasonable?

The solutions in proposal flow D:

Take the mode of free unlocking of bicycles in a short time.

The description of proposal flow D:

In terms of charges, the price range of Hellobike is more reasonable than the other two companies. Users who sign up for Hellobike change their bikes for the first time has 15 minutes riding for free: It means after locking the bike in 10 minutes you can ride any Hellobike again in 15 minutes for free. This offer is limited for one time to one user per day and the time period is 6:00-23:00. After 15 minutes, the charge is 1 yuan every 30 minutes. Bicycles can be used free after night till 23 a.m. This charging range is more humane and can satisfy users who ride in short time. This charge mode could avoid paying for two times. Ofo and mobike lack flexibility to simply charge for the length of time. It is not cost-efficient for users to unlock the bike again in a short time. We recommend that users be rewarded during rush hours between 7 a.m. and 10 a.m. and between 5 p.m. and 7 p.m., when they ride bicycles from low-demand areas to high-demand areas, such as downtown business districts. Users who meet the requirements can get an offer for free riding. It is conducive to adjusting the uneven distribution of sharing bikes in different areas and it satisfies demand of users.

Proposal flow advantages:

1. Within 15 minutes, free change or re lock, reduce extra expenses for short distance parking lots.
2. Free cycling at night can improve the utilization rate of shared bicycles at night and reduce the expenditure of people riding at night.
3. Usually electronic parking areas are monitored to reduce vandalism, theft and illegal occupation of shared bikes.

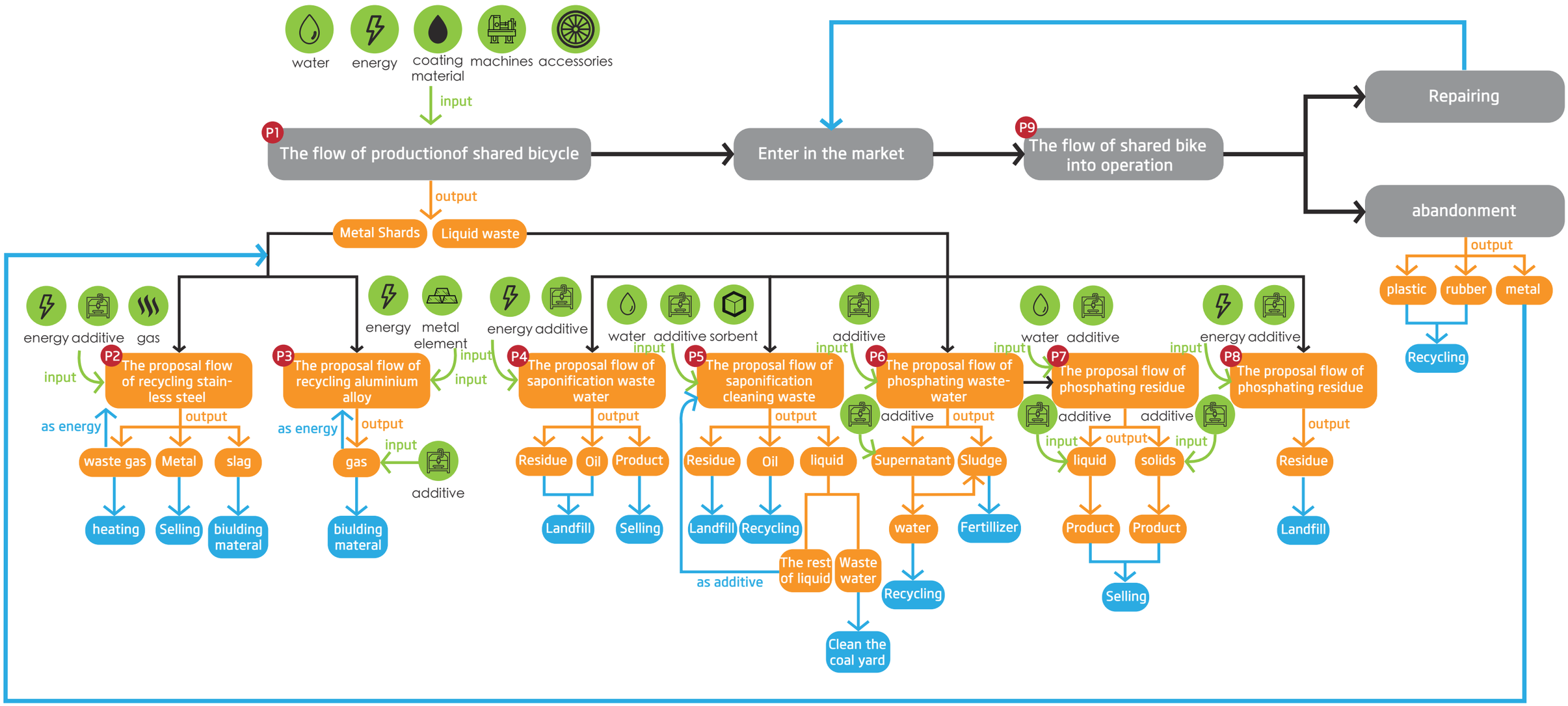
Problem E:
After unlocking the bike, it was found that the bike was damaged and the customer service could not handle the repairs in time. This will impact on the user experience.

The solutions in proposal flow E:
Improving repair system

The description of proposal flow E:
n the process of using shared bicycles, many users report that after unlocking, they find that the bicycle is damaged and cannot ride. It is unfair for ofo and Mobike users to pay for the length of time after the lock is unlocked. It is means that users cost 0.5 to 1 yuan just for unlocking the bike. Here's a suggestion: reporting the damaged bike to APP immediately after unlocking, closing the lock immediately after successful feedback, and changing the next bike for free. In this way, users do not need to pay for the time just unlocking the bike and it is more fair and reasonable for users. At the same time, the operator can also adopt a corresponding reward system. For users who reports damaged bikes the operator gives them free riding time. This system can be extended to users reporting violations of the use of shared bicycles, such as users reporting that someone possesses himself of the shared bike. Once reported and verified, the operator gives the user the corresponding time award. This system is conducive to the operators of bicycle management, but also to encourage users to supervise the use of shared bike.

Proposal flow advantages:
1. Submit repair feedback to enable administrators to repair the problems of shared bicycles in time.
2. Reporting can enable managers to find and deal with damaged or stolen shared bikes quickly, investigate the saboteurs and thieves' responsibilities according to law, so that shared bike companies can get the compensations.
3. Rewards can improve the enthusiasm of whistleblowers, establish social morality and maintain legal order.

Comprehensive process



P1 ~ P9 Detailed flow can be checked in the process with corresponding numbering

The input in the flow

The output in the flow

The proposal treatment

Ⅳ The project of new shared bike design

5.1 The comparison of the comfort of OFO, Mobike and Hellobike

The comparison of the comfort

	The weight ofthe bike (kg)	Frame material	Frame size (cm)	Grip height from ground (cm)	Adjustable extent of saddle (cm)	The type of bicycle brake	Transmission mode	Basket	Saddle	Tire	Tire radius (cm)	The proportion of the market (%)
OFO	15	Aluminium alloy	60	105	17	Front brake: V-brakes Rear brake: Traditional cantilever brakes	Chain transmission	No	Moderate soft Saddle area: length:25 cm wide: 21 cm	Solid tire Material: rubber	29	49.2
Mobike Classic	27	Stainless steel	63	101	14	Front brake: Traditional cantilever brakes Rear brake: Traditional cantilever brakes	Axle drive	No	Harder Smaller saddle area: length:24 cm wide: 21 cm	Solid tire Material: rubber	27	35.4
Mobike Lite	18	Stainless steel	58	101	14	Front brake: Traditional cantilever brakes Rear brake: Traditional cantilever brakes	Chain transmission	Yes	Moderate soft Smaller saddle area: length:24 cm wide: 21 cm	Solid tire Material: TPE	27	
Hellobike	16	Aluminium alloy	58	106	5	Front brake: V-brakes Rear brake: Traditional cantilever brakes	Efficient chain transmission	Yes	Moderate soft Larger saddle area: length:26 cm wide: 23 cm	Solid tire Material: rubber	27.5	15.4

The advantage

⚠ The Hellobike has introduced accident insurance for users, double compensation for accident with bad weather. In this way, users can guarantee their safety during riding.

The description of “The comparison of comfort”

We will evaluate these four bicycles through the following items: OFO, Mobike (classic), Mobike (Lite), Hellobike, and combine multiple factors to prepare for the improvement of bicycle design.

Judging from the weight and material of the bicycle, OFO is the lightest of the four and the weight is 15kg. The reason of the lightest one is that its frame material is aluminum alloy. OFO parts use the best, such as solid tyres and anti-theft screws in the same class of products, so the bike is more durable. Hellobike: 16kg is slightly heavier than OFO, but it is much lighter than the remaining two bicycles. Hellobike also adopts aluminum alloy frame, and its parts and materials have little difference from OFO. But Hellobike uses symmetrical design, and most of the parts are standard parts, so it saves some of the cost than OFO. But the efficient transmission device on Hellobike is slightly heavier, so that its body is heavier than OFO. The last two bikes of Mobike: classic and Lite are made of stainless steel and the weight is 27 kg and 18 kg. Because the weight of stainless steel is heavier than that of aluminum alloy. The Mobike classic has a chain-less transmission system at the rear wheels (described in the "transmission mode" section), while Lite uses the traditional chain transmission system. So the Lite is lighter than the Classic. Because the Classic is heavy it is harder for woman to ride it. Men feel tired when riding on uphill. Due to the inconvenience caused by the Classic, the official version is being launched gradually by Lite. At this stage, the Lite is still being promoted. These two models are coexisting in the market now.

From the frame size of the bike, the size of the Mobike classic frame is the largest: 63cm (Pic.01). The OFO frame size is 60cm (Pic.02). The smallest frame size is Mobike lite and Hellobike: 58cm (Pic.03). For slimmer users, Mobike classic is too tired to ride with a large frame. From the grip height from ground, the height of hellobike is the highest: 106cm. The two of Mobike is lowest: 101cm. OFO is 105cm between them. For slimmer users, the bigger the bike is, the more tired it is. But considering that each person's stature is not the same, we suggest whether we can give the improvement according to the average height and stature of men and women in Nanjing.

01

The size of the Mobike classic frame is: 63cm.

02

The size of the OFO frame is: 60cm.

03

The size of the Hellobike frame is 58cm.

Four saddles users can not be adjusted, but internal maintenance satff can use special tools to adjust. The height of the saddle affects the comfort during riding. Here four adjusting ranges of the saddle are given. OFO's saddle has a wide adjustable range of 17 cm. The adjustable range of Mobike classic and Mobike Lite is 14 cm. Hellobike has the lowest adjustable range of 7 cm.

From the bicycle brake mode, except for the Mobike classic of the front and rear traditional cantilever brakes (Pic.04), the other three are front v-brakes (Pic.05) and rear traditional cantilever brakes. The principle of traditional cantilever brakes is the friction between brake shoe and hub to generate braking force. The advantages of this brake are that the parts are simple and inexpensive when they are manufactured, and they are basically maintenance-free in the course of use. This brake mode does not damage the rim. The disadvantage of traditional cantilever brakes are: the brake ability is not strong and sensitive. If the brake block sticks to the oil, there will be slippage phenomenon. The V-brakes produce braking force through two rubber clipping wheels. The advantages of the V-brakes are light weight, simple structure, convenient maintenance, and better braking effect. The drawback is that if the rim is wet, the braking ability will decrease, and it will be slightly dangerous in rainy days. OFO, Mobike lite, and Hellobike use front V-brakes, which make the brakes more stable. The Mobike classic is stable than the former.

04

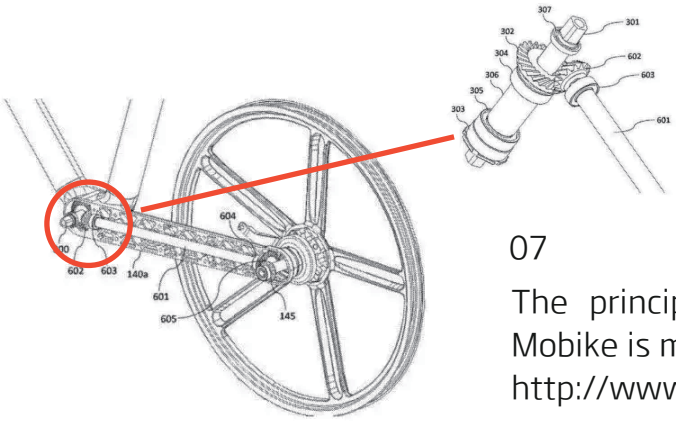
It is the photo of traditional cantilever brake.
https://kknews.cc/car/oye2oe6.html

05

It is the photo of traditionalv-brakes.
https://kknews.cc/car/oye2oe6.html

In terms of transmission mode, except for Mobike classic, the other three are chain transmission. The purpose of Mobike classic is to reduce chain transmission damage. The principle of the chain-less transmission (Pic.06) is through the bevel gear-rod transmission, that is, through two gears with a 90 degree occlusion, the rotating power from the middle shaft is transmitted to the rear shaft, driving the rear wheel to rotate (Pic.07). The advantage of this type of transmission is that the chain-less transmission does not have the embarrassment of "chain dropping", nor does it hang into the trouser legs or skirt corners during the ride. The disadvantage of this kind of transmission is also obvious: the device is slightly heavy and on the side of the bicycle, it is easy to make the center deflect to one side during the ride, resulting in a decrease in riding comfort. OFO, Mobike lite, and hellobike are all chain transmission, but they are slightly different: OFO, Mobike Lite are traditional chain transmission, although the system is light but there is a "chain dropping" phenomenon in the ride, not only to increase users' concerns about riding, but also increase the pressure for company maintenance. Hellobike has been improved on the traditional chain transmission system into a high-efficiency chain transmission system, which can avoid chain dropping in the drive, and does not appear to dirty skirts or trouser legs during riding.

06 These are transmission modes of Hellobike, OFO and Mobike Clasisic.
https://kknews.cc/car/oye2oe6.html

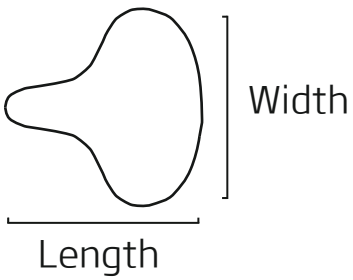


07

The principle of the chain-less transmission on Mobike is made of two gears with a 90 degree.
http://www.sohu.com/a/153967406_819609

From the existence of baskets, OFO and Mobike classic have no baskets. This is very unfriendly to office workers or buyers who need to carry handbags. Hanging things on the front of the bike will only increase the danger of driving. Both Mobike lite and Hellobike have baskets that are fixed to the head tube and do not swing with the grip, avoiding the steering risk of traditional bicycles due to overweight basket.

From the saddle comfort point of view, the saddle of Mobike classic and lite is hard, and the saddle size is narrow, length 24 cm / width 21 cm. It is not comfortable at all. The saddle of OFO and Hellobike is moderate soft, and the saddle size is wide. The size of OFO saddle is length 21cm/ width 25cm and the size of Hellobike is length 26cm/ width 23cm (Pic.08). Hellobike saddle uses the vacuum integrated foaming technology, which is more flexible. However, it ignores individual differences, which leads to reduced comfort. OFO saddle are not as advanced as Hellobike, but they are moderately soft with large saddle area and higher comfort. These four bikes cannot adjust the height of the saddle. Most of the girls will have difficulty in riding.



07

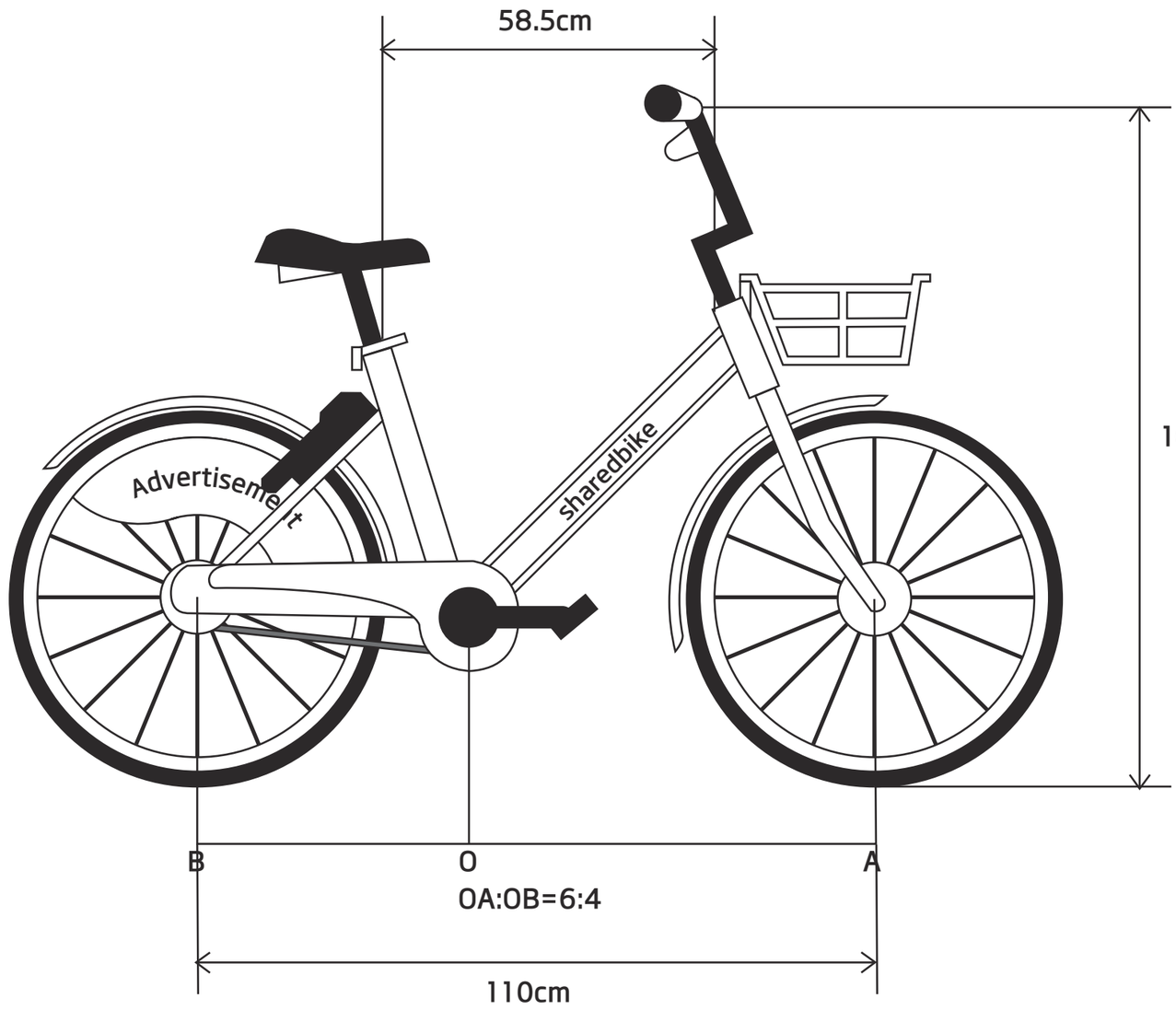
These are saddles of Mobike, OFO and Hellobike.

From the tire material point of view, the four bicycles are solid tires. The purpose is to prevent tire bursting to reduce maintenance. Both OFO and Mobike classic are ordinary rubber solid tires. Mobike Lite adopts new material TEP (Triethyl phosphate). Compared with the ordinary rubber solid tires, not only the weight is reduced by 20%, but also the vibration resistance and durability are greatly improved. The material is recyclable and environmentally friendly. The outer (grey) tire is hard to ensure durability, while the inner (orange) tire is soft to ensure ride comfort. Hellobike tire material is the same as OFO, but its tire inner ring thickening has better vibration resistance.

From the tire radius, the maximum tire radius of OFO is 29 cm, and the minimum tire radius of Mobike is 27 cm. The radius of hellobike's tire is 27.5 cm. Tire radius affects the distance of alex of tires. According to the data, shorter distance of axle is more effect-saving. Therefore, the tire size of Mobike is more suitable.

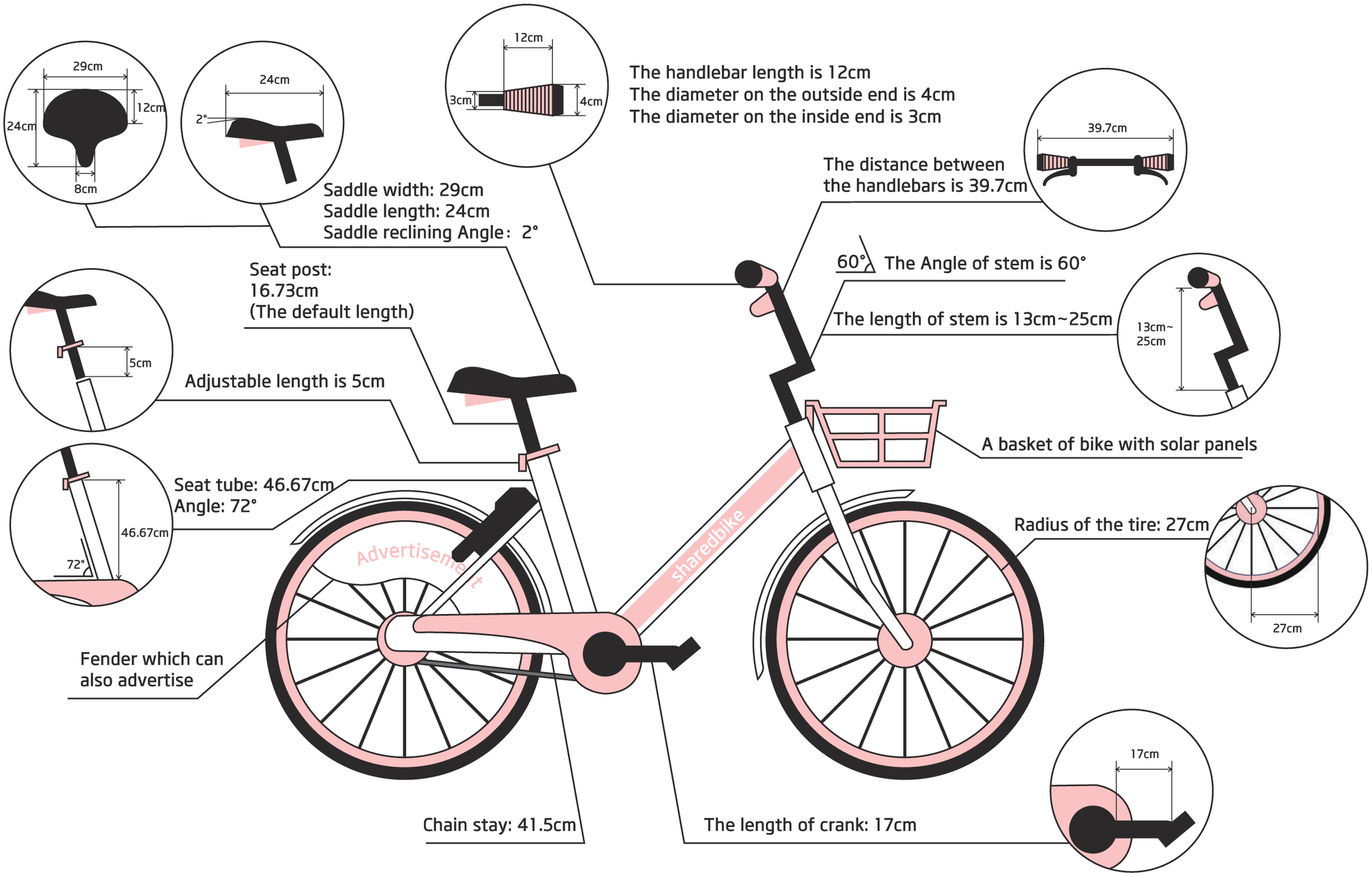
5.2 The new shared bike design

The frame design of shared bike



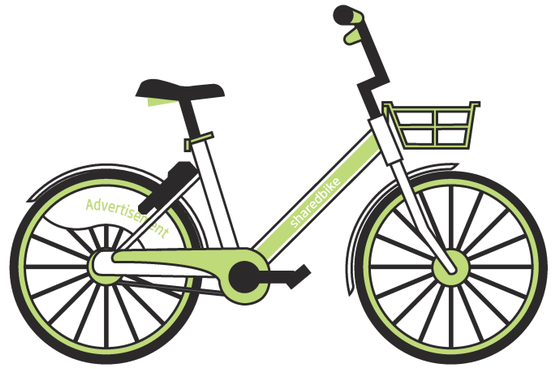
Detail design of carframe

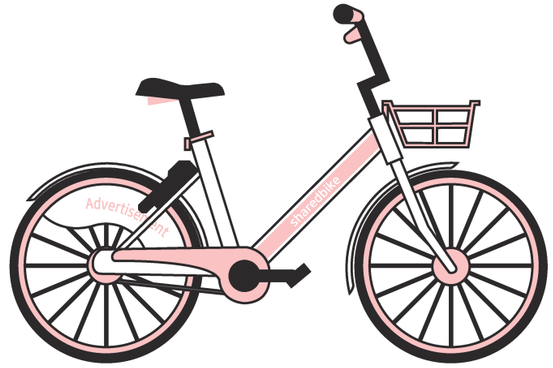
Detail design of shared bike for women



Detail design of shared bike

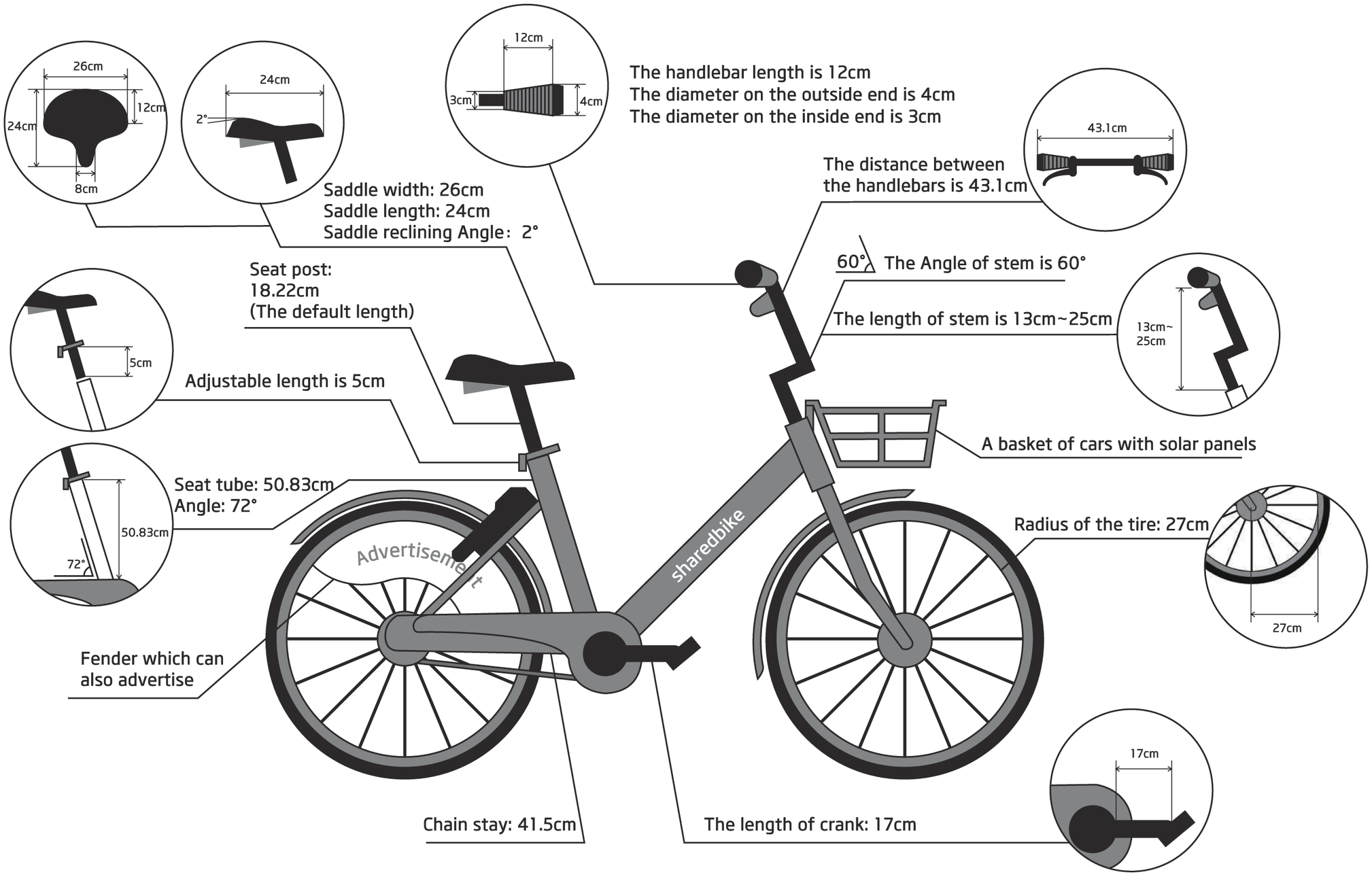
Color of shared bike for women





Women prefer colors:

Detail design of shared bike for men

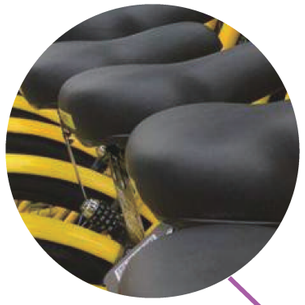


Detail design of shared bike

Color of shared bike for men

men prefer colors:

The meterials of shared bike



Material: rubber

Good elasticity, wear resistance, moderate hardness, low cost

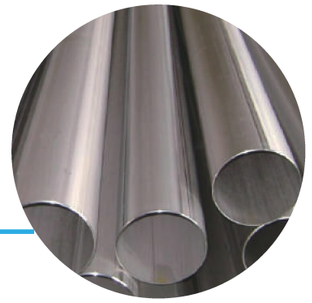
The saddle

Material: sustainable polymers

Sustainable polymer is a new material to replace plastics. It is made from plant or agricultural waste. It is healthy and economic, renewable, easy to be recycled and decomposed.

The basket of bike

The handlebars



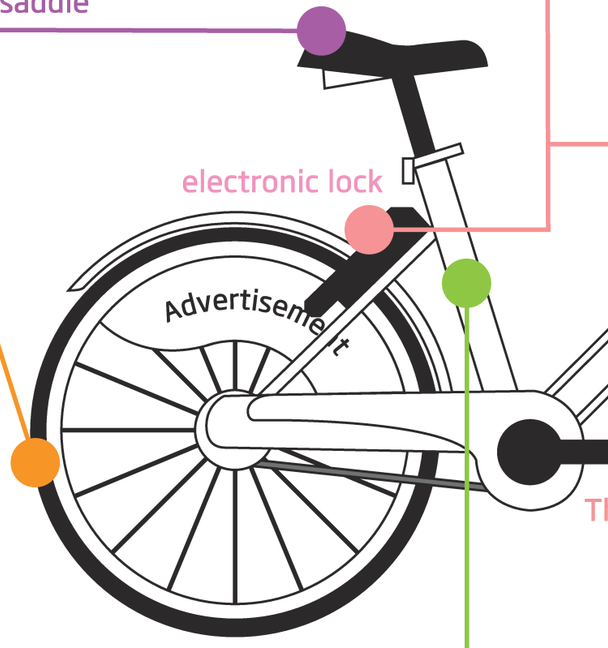
The basket of bike

The tyre

Material: TEP

The wheels are made of TEP material, which is lighter than ordinary wheel material, has better shock absorption performance and durability, is free of inflation, and can be recycled.

electronic lock



The pedals

Material: aluminium alloy

Aluminum alloy is lighter than stainless steel and cheaper than stainless steel. Good strength, corrosion resistance and easy recovery.

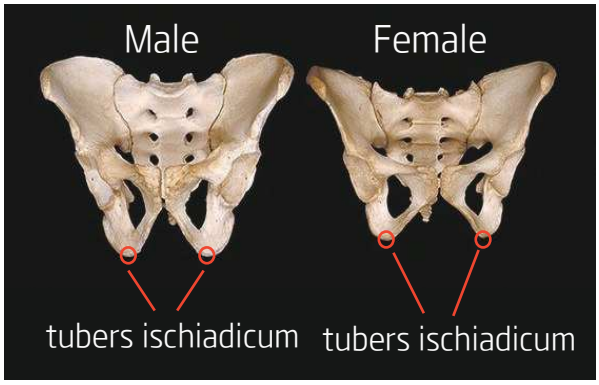
Material: UV coatings

UV is currently the most environmentally friendly coating. UV coating does not contain any volatile substances, is a green, healthy, environmentally friendly coating. UV coating hardness, wear resistance, friction resistance, durability, high efficiency, low cost of coating

The design description of new bike

Through the table "The comparison of comfort", we find that each brand of shared bike has its own advantages. We aim to design a bicycle for male and female users in Nanjing by combining the advantages of three kinds of bicycles and referring to the relevant knowledge of ergonomics.

Before the new bike design, we got the following data by consulting relevant information The sample of Nanjing Government's survey on shared bike was 122 males and 115 females, totaling 237 people. In terms of age group, 102 people aged 23-35 (43.04%), 83 people aged 36-59 (35.02%), 38 people aged 18-22 (16.03%) and 14 people aged 60 and over (5.91%) are users of shared bike [1]. It is clear to find that people aged 23-35 use shared bikes the most. According to the data, the average height of people in Nanjing in this age group is 172.6 cm for males and 159.9 cm for females. Meanwhile, the average shoulder width of males and females in this age group is 43.1 cm and 39.7 cm. The palm width of males and females in this age group ranges from 7.1 cm to 9.7 cm [2]. The following data are also involved in the design of the new bicycle: the crotch height of males and females in this age group is 78.2 cm and 71.8 cm [3], the distance between the tubers ischiadicum of females is about 23 cm, and the distance between the tubers ischiadicum of males is about 20 cm (Pic.01). We will improve and design a new bike by data collection above.



01. The size of the Mobike classic frame is: 63cm.
picture source: http://health.sohu-.com/20130416/n372864399.shtml

[1] http://www.nanjing.gov.cn/hdjl/zjdc/wsdc/dcbg/201709/t20170925_5030233.html
[2] YANG Feng. Analyze the Bicycle Frame Characteristics of through the Ergonomic Theory. Hefei University of Technology 2010; 33-34.
[3] HUANG JIngming. Humanrized Design in Bicycle Design Application and Research. Hubei University of Technology 2011; 17.

The frame design of shared bike

The frame:
Through the comparison, we found that: the frame of OFO and Hellobike is relatively light: 15kg and 16kg. This is because their frames are made of aluminium alloy, which is lighter than the stainless steel frame of Mobike. Therefore, our new bike uses aluminium alloy frame, which not only saves cost, but also makes riding fatigue less.
As for the size of bicycle, the length of top tube is an important data. This length is measured by the table "The comparison of comfort" with an average of 58-59 cm.

The chain stay:
By searching for information, the length of the chain stay is controlled from 40.5 cm to 42.5 cm, and there will be no bump during the ride [4]. Here we take the median of 41.5 cm.

The crank:
According to the National Bicycle production standards, the crank length is suitable for 16.5-17.5 cm, here we take 17cm [5].

The angle between seat tube and horizon:
For the vertical dimension, the angle between seat tube and horizon should be controlled at 71-73 degrees. We choose 72 degrees.

The seat tube:
The length of the seat tube = crotch height *0.65 [6] according to the formula. According to the average crotch height of male and female in Nanjing, 78.2cm and 71.8cm respectively. So the length of seat tube for male is 50.83 cm and 46.67 cm for female. The length of the seat tube affects the rider's riding feeling. It is not comfortable for appropriate to ride too high or too low. As for the length of the seat post, we calculate the sitting height first. According to the formula: sitting height= crotch height *0.883, the sitting height for male is 69.05cm and for female is 63.40cm. Then, the length of the seat post= sitting height- the length of the seat tube. The length of the seat post for men is 18.22 cm and for women is 16.73 cm. We set this value as the initial value of the length of the seat post for the shared bike.

The seat post:
Based on the above, it is estimated that the height of the seat post for men and women from 180cm to 190cm is about 2 cm higher than the initial value, so the adjustment height of the seat post is 5 cm for Hellobike.

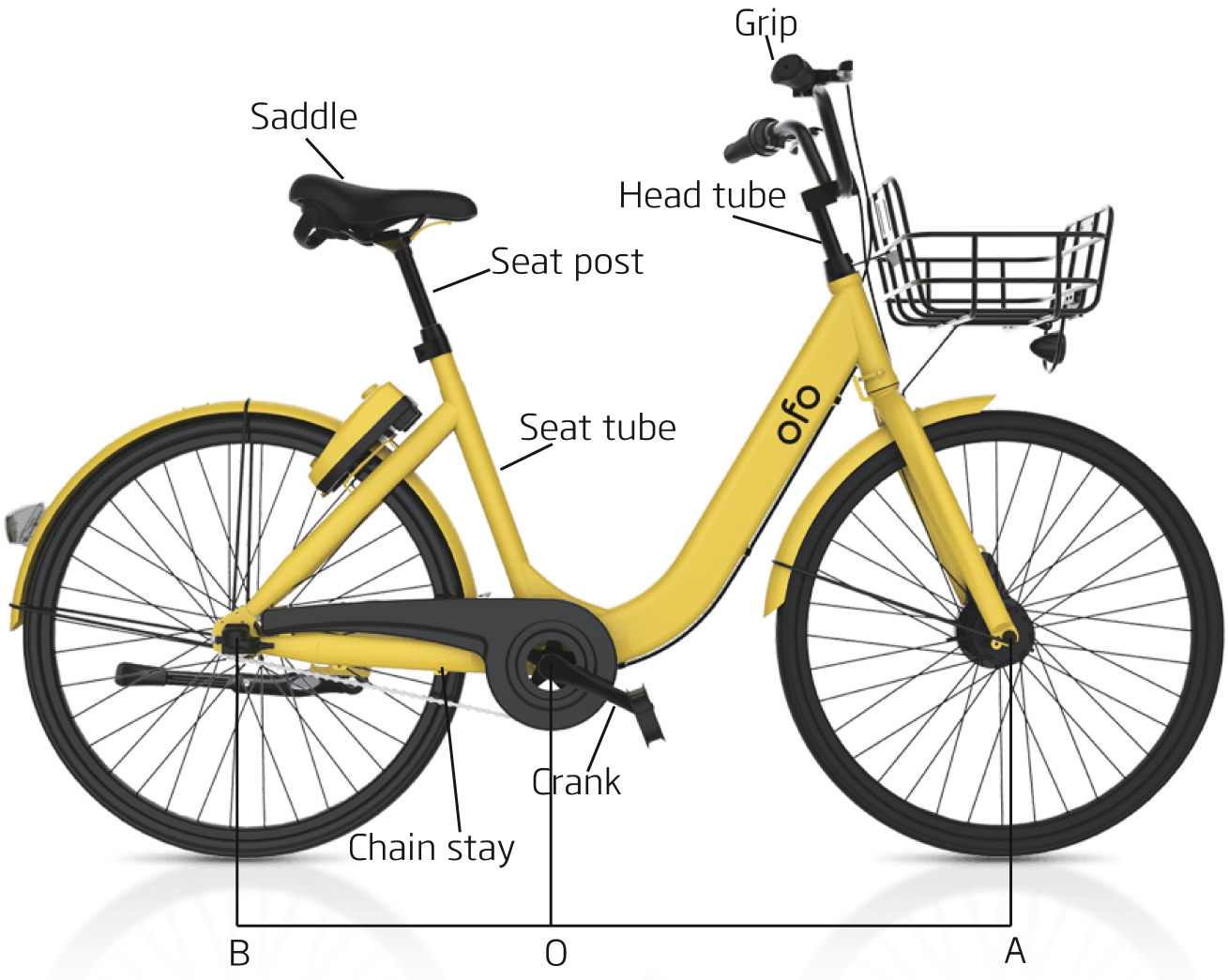
The head tube:
Next is the head tube. According to the industry regulations, the angle between the head tube and the horizon should be between 60 and 80 degrees. The length of the head tube also has the corresponding standard: 13.0-25.0 cm.

The grip:
According to the ergonomics, the height of the grip from the ground should be higher than the seat height and the riding position is the most comfortable in this way. Therefore, we choose 106 cm from Hellobike, which is the most comfortable level for public evaluation, as a reference.

[4] TANG Bei. Appearance Design of the City Public Bicycle. Kunming University of Science and Technology 2014; 22.
[5] TANG Bei. Appearance Design of the City Public Bicycle. Kunming University of Science and Technology 2014; 21.
[6] https://zhuanlan.zhihu.com/p/41381939

frame ratio:

In terms of size, the distance AB (Pic.02) of the two tyres affects riding comfort. Generally speaking, the distance of AB is controlled between 105 cm and 110 cm. If the distance of AB is large, the seismic performance of bicycle is better. Therefore, we choose 110 cm as the distance between the two tires. The front center distance of the bicycle is OA, and the proportion of the first half and the second half is 4:6 according to the load-bearing capacity of the bicycle [7]. According to the bicycle structure, the distance AB of the two tires is divided into OA and OB segments. OA: OB = 4:6, so OA is 66 cm and OB is 44 cm. When the distance between transmission center and OB is small, the flexibility of the bike is better. Because the back half of the bicycle is load-bearing, the OB is safer when the distance is small. Therefore, according to the table "The comparison of comfort", we choose the smallest tire radius. We choose Mobike's tire radius: 27cm.



02 The structure of a bicycle
https://blog.bhuman.it/alibaba-punta-sul-nuovo-bike-sharing-di-ofo-1fc9260fd578

[7] ZHOU Jian. Discussion on Design of Bicycle [J]. Electric Bicycle 2009; 11: 29-31.

The details design of shared bike

The saddle:
In the design of saddle, the physiological structure of men and women should be taken into account. The distance between female tuber ischiadicum is about 23 cm, and that between male tuber ischiadicum is about 20 cm. Therefore, the saddle width for male bicycle is 24-26 cm, and that of female bicycle is 26-29 cm. The length of the saddle is generally between 22 and 24 cm, and the width of the top of the saddle is between 6 and 8 cm. From comfort point of view, the saddle of OFO is moderate soft, and the saddle area is suitable (the saddle length is 25 cm and the width is 21 cm). Therefore, on the basis of OFO bicycles, we have improved the width of male saddle to 26 cm and female saddle to 29 cm. Then the length between two grips is calculated according to the average shoulder width of men and women, which is 43.1 cm and 39.7 cm.

The grips:
the length between two grips is 39.7-43.1 cm. The shape of grip also affects riding comfort: if the diameter of grip is too small, the torque will decrease; if too large, it will reduce grip strength and reduce flexibility. It will increase the bending of fingertip bones and will also lead to fatigue during riding. Therefore, the diameter of the grips is about 4 cm at the top and 3 cm at the end. According to the palm width of men and women between 7.1 and 9.7 cm, the length of grip should be set at 12 cm. As OFO and Moike classic, there is no basket and it is inconvenience.

The basket:
In our new bike design, there is a basket. Solar panels is installed in the car baskets to provide power for the lock. In terms of locks, except for OFO, the other locks contain GPS chip. When we design a new bike, we also add chips to the locks, which is convenient for users to find bikes and for the management.

The transmission:
In terms of transmission, we still use the traditional chain transmission. Although Mobike's axle drive mode does not have the risk of "chain drop", it is not considered because of the impact of the device on riding.

The fender:
Considering that the traditional chain transmission is stained with water and mud, there is a risk of chain falling. In the rear tire of bicycle, we add fender to prevent splashing of water and mud. At the same time, advertisements can be printed on the fender, which is conducive to the promotion of shared bikes.

[8] http://muchong.com/html/201004/1970296.html
[9] http://www.sustainable-coatings.com/files/economics.pdf

The colors design of shared bike

In order to meet the diversified needs of users, we designed men's shared bicycle and women's shared bicycle respectively.

According to the user analysis of sharing bicycles listed above, the majority of users aged 23 to 35 years old accounted for 43.04% of the total. Therefore, we refer to some papers and research reports on color preferences of Chinese college students approaching this age group.

According to the research, The color order of men from favorite to least favorite is white-black-blue-green-yellow-red. Men prefer a neutral color system. Therefore, according to men's preference for color, in our design, we chose some neutral colors for men's shared bicycles: silver gray, black and dark blue.

The order of women's favorite to least favorite colours is white-black-green-blue-red-yellow [10]. Women usually prefer a variety of colors. So when we design women's shared bicycles, we choose some combination colors: pink and white combination, yellow and white combination, light green and white combination.

To sum up, the new bicycle takes into account the needs and preferences of different gender users. It chooses the most appropriate fittings on the new bike, so that shared bike can become a popular short-distance travel mode.

[10] YU Chenying. A Study on Colour Preference and Metaphorical Representation of College Students. Nanjing Normal University 2017; 13.

The materials design of shared bike

The frame:
The main frame of the bike is made of aluminium alloy. Aluminum alloy is soft and lighter than stainless steel. The density of aluminium is 2171 g/cm3, which is about one third of the density of steel. The price is cheaper than stainless steel. Good strength, corrosion resistance, easy regeneration (low melting point, lower regeneration cost than stainless steel). At present, there are more aluminium alloy recycling companies in China than stainless steel recycling companies, and aluminium alloy recycling technology is more mature [1]

The tyre:
The tyre is made of TEP material, which is lighter than ordinary tire material, has better shock absorption performance and durability. It is free of inflation, and can be recycled.

The baskets, handlebars, and pedals:
baskets, handlebars, and pedals use sustainable polymers, which are plastics that are environmentally friendly, healthy, economical, renewable, and easy to recycle and decompose.
Sustainable polymers currently commercially produced are made from starchy plants such as corn or sugarcane and seed oils such as soybeans or other vegetable oils. Scientists around the world are studying ways to make polymers from non-food-source materials such as switchgrass and corn stover.
At present, the biopolymer materials produced by DuPont Sorona EP Company are composed of 20% to 37% corn by weight. They have strength and ductility properties. They are natural substitutes for PBT (polybutylene terephthalate) in automotive, electronic, petroleum and natural gas industries. [2].

Coating:
The proposal coating is UV coating, which is the most environmentally friendly on the market. It is curable when rays in the ultraviolet rays. Under the irradiation of ultraviolet light, the initiator decomposes, produces free radicals, initiates resin reaction and solidifies into film instantaneously, which is the most environmentally friendly paint at present. UV coating does not contain any volatile substances. It is a green, healthy and environmentally friendly paint. UV coatings have high hardness, good wear resistance, good friction resistance, durability, high efficiency and low cost (normally half of the cost of conventional coating, tens of times the efficiency of conventional coating) [3]. UV coating is easy to apply and has good ductility. It only takes 130 liters to apply 1239 m2 [4].

Rubber
Good elasticity, wear resistance, moderate hardness, low cost

[1]https://zhidao.baidu.com/question/1989335900404645547.html
[2]https://csp.umn.edu/sustainable-polymers-101/
[3]https://baike.baidu.com/item/UV%E6%BC%86/4589855?fr=aladdin
[4]http://www.sustainable-coatings.com/files/economics.pdf

Ⅶ A vision of futurity

On the basis of the time line of shared bike putting into use, we gradually analyzed the problems in the production process and operation process. This is to reduce waste of resources, reduce emissions and pollution, focus on user experience as the core, and solve the problems. After completing the optimization of production process and operation process, we redesigned a new shared bicycle model. Referring to the most ergonomic parameters, we designed the frame and some details. We also considered the color of bike by analyzing the user groups and user habits. The new shared bicycle design includes selecting the most pollution-free and sustainable new materials. The design of our new bike hopes to achieve the main goal of zero emission, improve user experience and solve social problems.

In recent years, China has paid more and more attention to environmental protection and other issues.
Since 2013, in view of the air pollution, water pollution and land pollution caused by the development of national economy, industrialization and manufacturing industry, the relevant departments of the state have promulgated ten policies on air pollution, water pollution and soil pollution, which have effectively provided measures for the treatment of pollution problems in subdivided areas [1].
In January 2015, the new environmental protection law was implemented, and relevant rules were promulgated many times.
In July 2015, the government deliberated and approved the Environmental Protection Supervision Program, which directly supervises the implementation of environmental protection matters.
Since July 1, 2016, a pilot water resources tax reform has been carried out. For the first time, environmental resources have been included in ratepaying, and then the whole country has been promoted.
A new environmental monitoring programme was released in November 2016.
In February 2017, the Ministry of Environmental Protection issued the Work Program of Air Pollution Prevention and Control in the Peripheral Areas of Beijing, Tianjin and Hebei in 2017 to control air pollution.
In March 2017, the government issued the Implementation Plan of Domestic Waste Classification System to guide residents to classify domestic waste.
In 2018, environmental tax will be aimed to solve the problem of insufficient enforcement in environmental protection matters. All environmental tax will be regarded as local tax.
It is expected that by 2020 China will build a comprehensive quality control system for environmental monitoring, such as air, surface water and soil [2].

[1] http://www.china-nengyuan.com/news/122677.html
[2] http://www.chyxx.com/industry/201704/517828.html
[3] https://www.yinhang123.net/dongtai/qqdt/54445.html

In addition to environmental governance at home, China joined the Paris Agreement in 2016. On the basis of the Paris Agreement, China put forward a number of goals for 2030: peak carbon dioxide emissions, and strive to reach the peak earlier. Compared with 2005, carbon dioxide emissions per unit GDP decreased by 60%. Non-fossil energy accounts for 20% of primary energy consumption. Forest stocks are increased by 4.5 billion cubic metres over 2005.

The above series of actions show that China has paid more and more attention to the sustainable development of environment and resources in recent years. Sustainable and low consumption has become a future goal of China and even the whole world. The sustainable concept of shared bikes with zero emission and low consumption designed by us will cater to the future of Nanjing and even a place in China. We believe that our sustainable shared bicycle system will usher in a bright future.

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