Experimental study of fouling performance of air conditioning system with microchannel heat exchanger

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Catalogue

1、Background

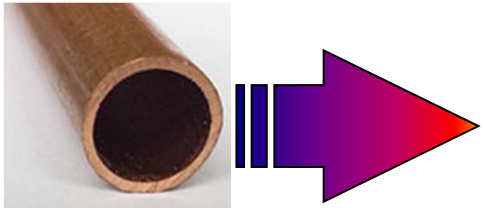
- 【**2013** China's National Bureau of Statistics】：China produced more than 100 million air conditioners, 80% of the world. They consumed power 800 billion kilowatt hour, 20% of the whole power consumed. Using about 270,000 tons of Freon refrigerant, 2/3 of the cost of the whole world, CO2 equivalent emissions were equal to 130 million vehicles.

Energy conservation and emissions reduction of air conditioner is urgent !

1、Background

- Developing new type of high efficiency heat exchanger is the main ways to solve energy conservation and emissions reduction problem of air conditioning .
- Microchannel heat exchangers is becoming the global research hot issues.

Fin-tube heat exchanger



MCHX(Al)

Energy conservation

High heat coefficient

Environmental protection

Decreasing of refrigerant charge

Green manufacturing

All aluminum structure, easy to recycle

Cost advantage

Lower weight, lower cost

Microchannel heat exchanger is an effective way to realize the energy conservation and emissions reduction of air conditioner ！

1、Background

- Microchannel heat exchanger can be widely used in business, automotive and household air conditioner, market capacity can reach

Business air conditioner

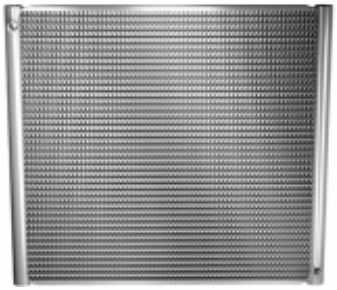
Automotive air conditioner

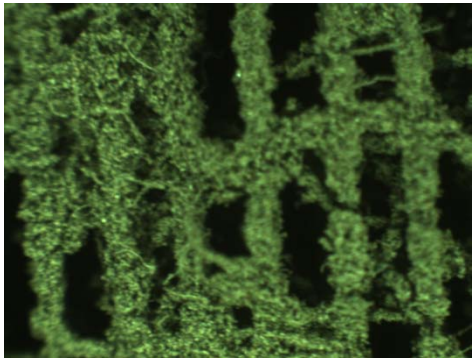
Household air conditioner

- U.S. EPA ,Europe HPA, etc. all list microchannel heat exchanger in the energy conservation and emissions reduction technologies and key research fields.
- "The Chinese household appliances industrial technology roadmap" list microchannel heat exchanger in the key developing directions.

1、Background

- Problems





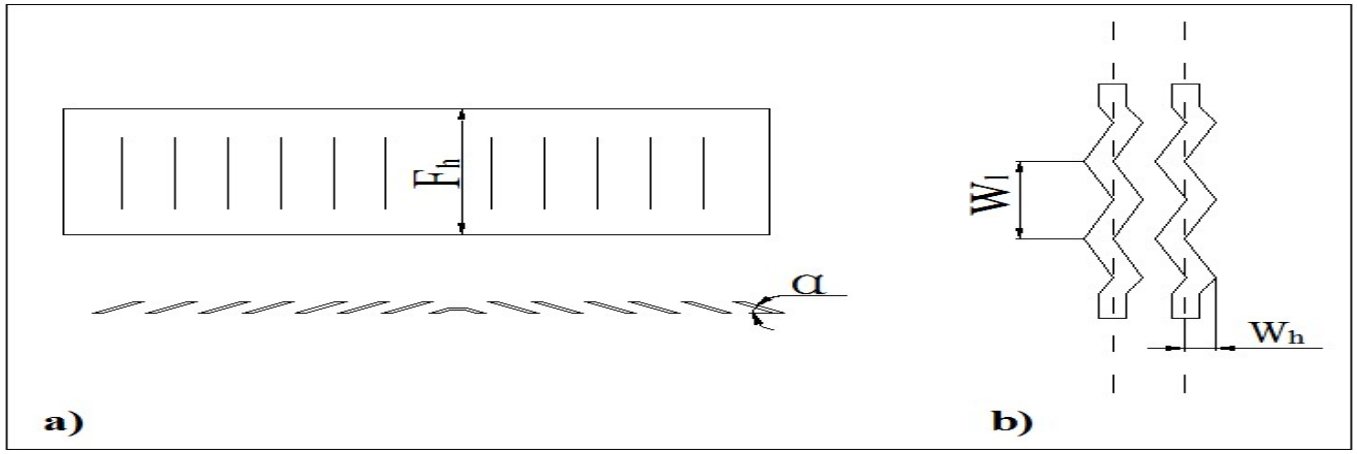
Fouling problem

Frosting problem

- The compact design of the microchannel heat exchanger and fin -flat tube network structure, lead the fouling problem and frosting problem.

2、Test Sample and Apparatus

- Two types of MCHX were tested in this experiment. One is louver fin MCHX(#1,a), the other is wavy fin MCHX(#2,b)



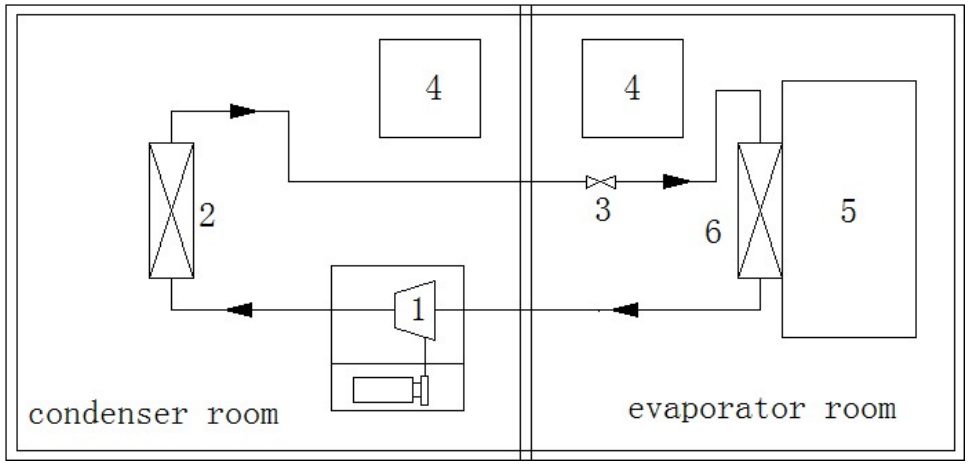
Louver fin sample

Wavy fin sample

Heat exchanger	#1(louver fin MCHX)	#2(wavy fin MCHX)
Dimentions(mm)	575x500x16	550x500x20
Fin thichness(mm)	0.1	0.1
Fin pitch(mm)	2.8	2.8
Fin height(mm)	8	8
Size of tube(mm)	16x2	20x2
Number of tube row	1	1
Wavy length/height(mm)	-	6/2.6
Window angel(°)	27	-

2、Test sample and Apparatus

- Apparatus: the enthalpy difference method test bench

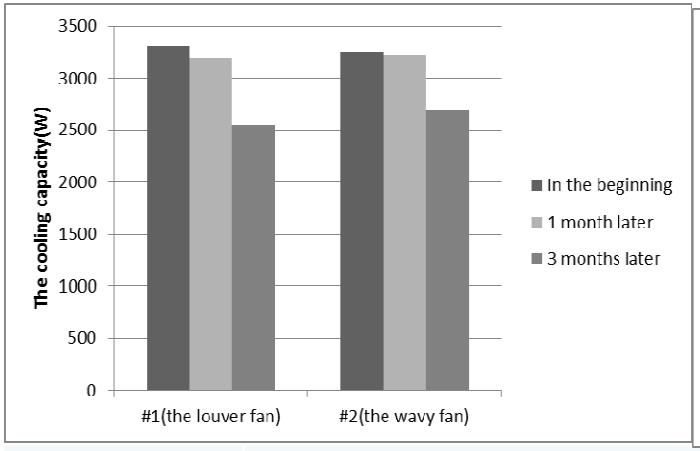


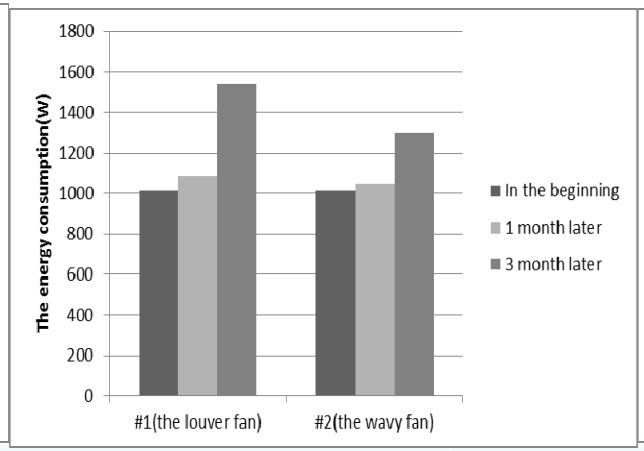
1 compressor; 2 condenser; 3 expansion valve;
4 environmental control; 5 wind tunnel 6 evaporator

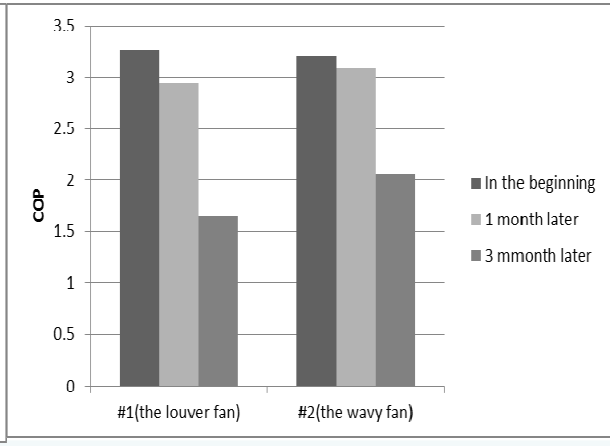
Measures Parameters	Testing range	Accuracy
Temperature	-10~50℃	±0.1℃
Power	0~5000 W	±5 W
Air-pressure drop	-50~500 Pa	±2.5 Pa
Heat transfer rate	±3%	
COP	±3%	

3、Results and Analysis

- The long-term performance of two air conditioning systems with louver fin and wavy fin MCHX were experimentally studied in the factory.







	#1			#2		
	Capacity(W)	Energy consumption(W)	COP	Capacity(W)	Energy consumption(W)	COP
3sse line	3304	1012	3.27	3248	1015	3.2
. month later	3197	1087	2.94	3225	1044	3.09
	-3.24%	7.41%	-10.09%	-0.71%	2.86%	-3.44%
3 month later	2544	1543	1.65	2688	1303	2.06
	-23.00%	52.47%	-49.54%	-17.24%	28.37%	-35.63%

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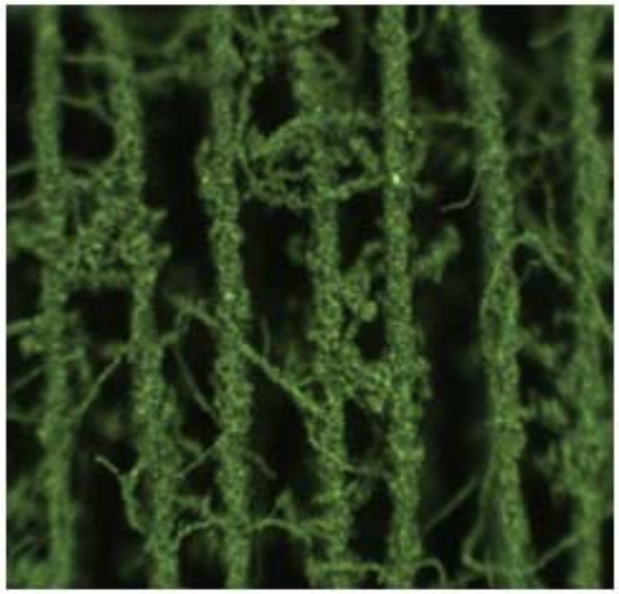
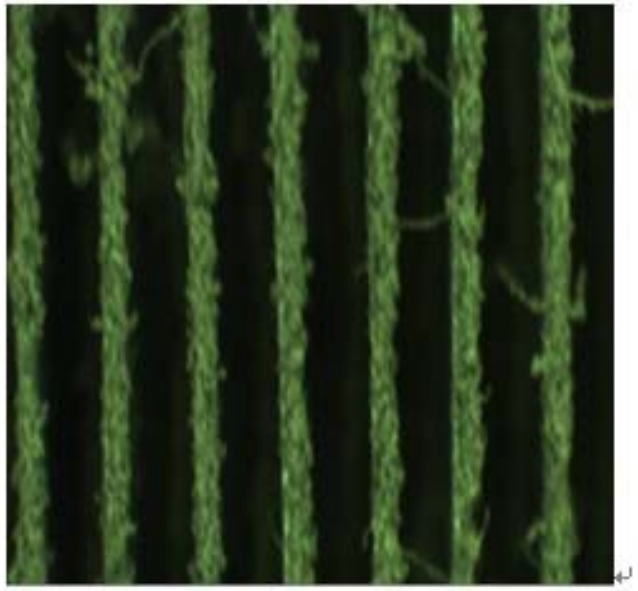


a)



b)

The dust on #1(a) and #2(b) of the group 1 air condition systems after 3 months

3、Results and Analysis

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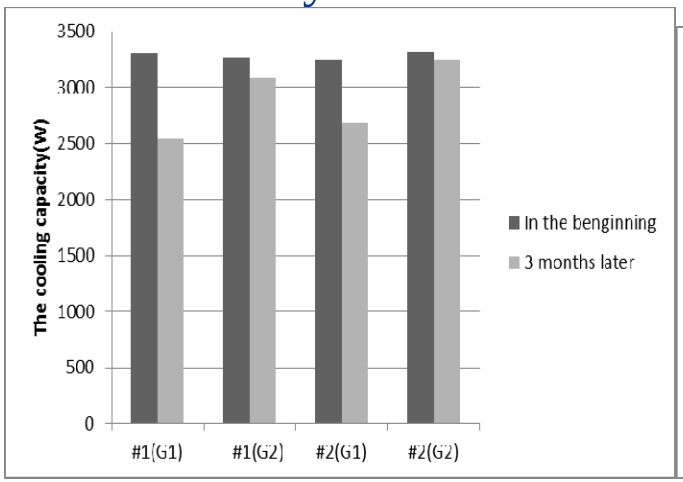

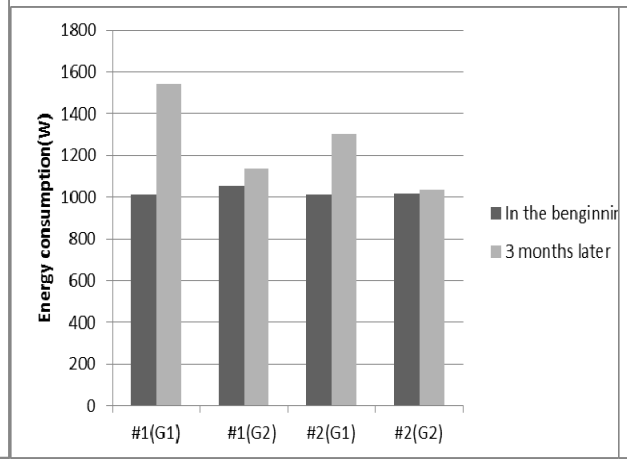

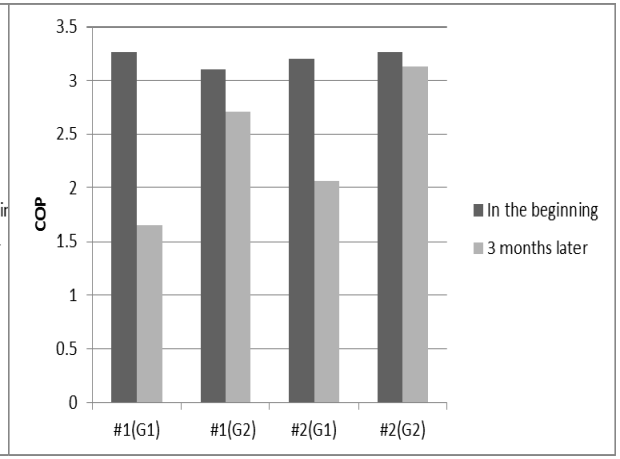

	#1				#2			
	GROUP 1		GROUP 2		GROUP 1		GROUP 2	
	Base line	3 month later	Base line	3 month later	Base line	3 month later	Base line	3 month later
Cooling capacity(W)	3326	3082	3270	3087	3248	2688	3317	3251
Energy consumption(W)	1025	1205	1056	1139	1015	1303	1016	1039
COP	3.25	2.56	3.1	2.71	3.2	2.06	3.27	3.13

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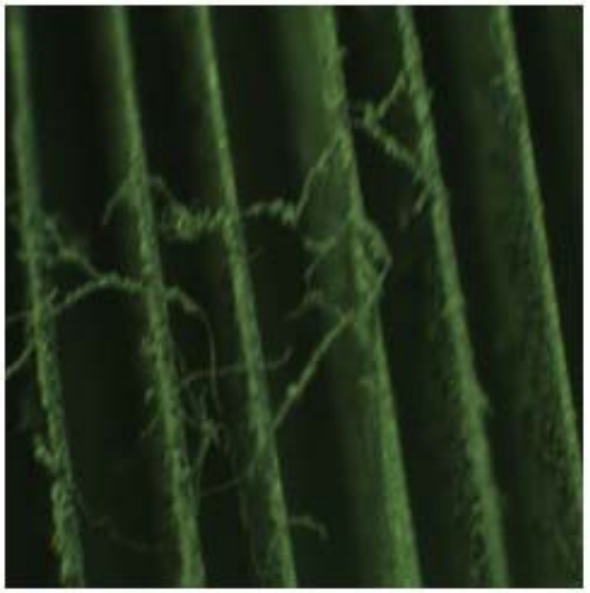

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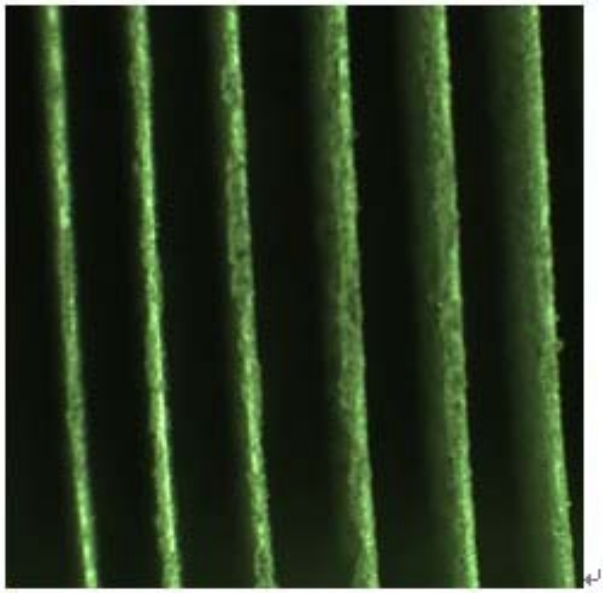

b)

The dust on #1(a) and #2(b) of the group 2 air condition systems after 3 months

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4、Conclusion

- The fan-back control strategy can help to solve the dust fouling problem effectively, for the air condition systems added the control strategy, the cooling capacity decreased by 5.5% and 2%, the energy consumption increased by 7.8% and 2.3%, and COP decreased by 12.3% and 4.3% for louver fin and wavy fin MCHX respectively 3 months later.
- The performance of the air condition system with wavy fin is better than the louver fin in both conditions. Especially after added the control strategy, the performance of the air condition system the wavy fan MCHX is much better than before. This can provide a solution to solve the dust fouling problem and provide advices for the further researches.

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Thanks！