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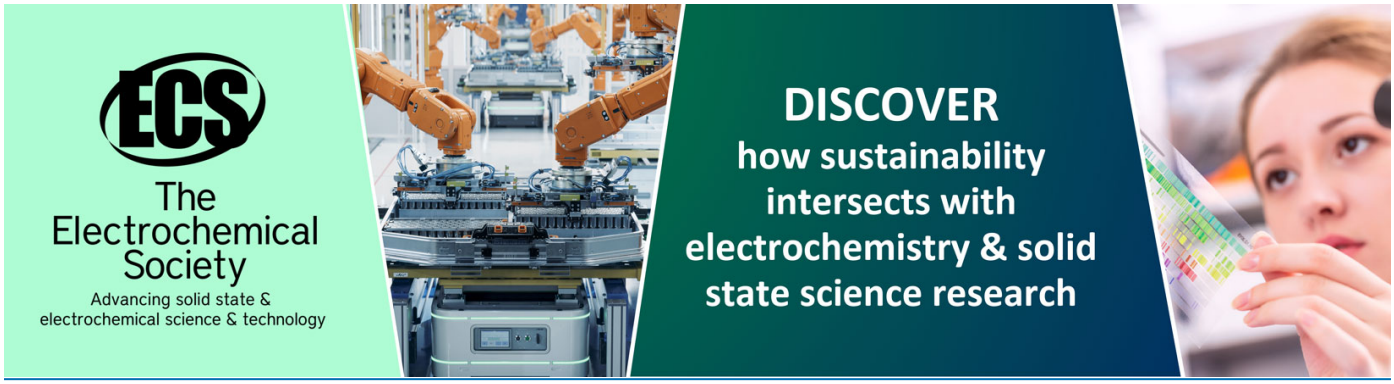

Study on the Difference of Moisture-keeping Performance between Fresh-keeping Packaging and Conventional Packaging

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Abstract. Packaging materials and packaging design have an important influence on the quality of cigarettes in the consumption process of unpacked cigarette packaging. In this paper, the effects of freshness-keeping packaging on moisture-keeping capacity, sensory quality, macula cigarette risk control after opening cigarette packaging were studied. The results showed: (1) After the opening of cigarette packages, the moisture content of cigarettes could be effectively maintained in fresh-keeping packages, while the moisture content of cigarettes in conventional packages would vary in a large range with time and environment (except equilibrium conditions). (2) In a high temperature test environment of 35 °C, the moisture content variation range of samples was as follows, paper-aluminium-plastic composite viscose hard freshness-keeping packaging > aluminium-plastic thermal package hard fresh-keeping packaging > paper-aluminium-plastic composite viscose soft freshness-keeping packaging. Differences in the type, material and process of freshness-keeping packaging may lead to differences in moisture retention performance, but the differences are not obvious.

1. Introduction

The moisture content of cigarette is an important index which affects its internal quality[1]. When the moisture content of cigarette is low, the taste of cigarette is strong and not mellow, and the irritant and pungent taste increase[2]. It can be seen that the sensory comfort of cigarettes is closely related to the moisture content. The total particle content of cigarettes with high moisture content is low, in which phenols decrease about 20% with the increase of moisture content, and the high moisture content has a great influence on the reduction of nicotine content, mainly because the increase of moisture content promotes the thermal cracking of nicotine[3,4]. Usually, propylene glycol, glycerin, sorbitol, compound moistening agent, natural moistening agent, synthetic moistening agent and other moistening agents are added to tobacco, so as to maintain moisture content of tobacco and improve sensory comfort[5-7]. In order to avoid the participation of humectant in the combustion of tobacco and prevent the mildew caused by the high moisture content of tobacco after application, the relevant research on improving the moisture content of flue gas by adding humectant in the filter rod is also reported.

2. Experimental

2.1 Materials

In order to investigate the difference of water retention performance between fresh-keeping packaging and conventional packaging, the difference of water retention performance between fresh-keeping packaging aluminum plastic materials or paper aluminum plastic composite materials, as shown in Table1.

Table 1 Design of experimental material for cigarette freshness-keeping packaging

fArray	Aim	Sample No.	Package type	Material	Forming
1	Fresh-keeping package & common package	1-1	Hard fresh-keeping package	Aluminum plastic	Hot sealing
		1-2	Hard common package	—	—
		1-3	Soft fresh-keeping package	Paper aluminum plastic	Glue
		1-4	Soft common package	—	—
		1-5	Some foreign brand hard fresh-keeping package	Aluminum plastic	Hot sealing
		1-6	Some domestic brand hard fresh-keeping package	Aluminum plastic	Hot sealing
		1-7	Full open fresh-keeping package	Paper aluminum plastic	Glue
		1-8	Full open common package	—	—
2	Aluminum plastic & Paper aluminum plastic	2-1	Hard fresh-keeping package	Aluminum plastic	Hot sealing
		2-2	Hard fresh-keeping package	Paper aluminum plastic	Glue
		2-3	Soft fresh-keeping package	Paper aluminum plastic	Glue

2.2 Main instruments & experimental method

MW 4420 microwave smoke moisture content tester (Tews Elektronik GmbH & Co.KG, Germany), kbf240 constant temperature and humidity box (binder, Germany), sodmax automatic test bench (sodim, France).

In the experiment, cigarette samples were used to test the performance of each fresh-keeping package, package small box sample refers to the representative package sample used to compare and test the performance of fresh-keeping package, and simulation open package small box test sample refers to the package small box sample containing cigarette sample.

Difference of water retention performance between fresh-keeping packaging and conventional packaging. Seal the test sample in the simulated open test box with good balance adjustment in the standard environment (22℃, 60% RH), high temperature and high humidity environment (35℃, 80% RH), high temperature and low humidity environment (35℃, 30% RH), low temperature and low humidity environment (10℃, 30% RH), low temperature and high humidity environment (10℃, 80% RH) specified in GB/T 16447-2004, and the cigarette samples were taken out after inspection at 24 h and 48 h respectively. Variation of water content was measured.

3. Results & Discussion

3.1Difference of water retention performance between fresh-keeping packaging and conventional packaging

There are 8 kinds of simulated open package test samples for fresh-keeping packaging and ordinary packaging small boxes, according to Table1. 11 parallel samples (including 3 for initial moisture content test and 1 for sensory quality evaluation) are placed for each sample in each test environment. Three parallel simulated open package test samples are taken at 24 h intervals to test the average moisture content of each box of cigarette samples, and record and sort them out The results are shown in Table2.

Table 2 Statistical table of periodic change of water retention of cigarette samples tested in simulated cigarette packages opened under different environments

Array	Sample No.	Test intervals/h	Moisture content of cigarettes in different test environment （Temperature/℃， Relative humidity/%RH）/%				
			22, 60	35, 80	35, 30	10, 30	10, 80
	Initial	0			13.97		
	1-1-1	24	13.99	14.11	14.00	14.01	13.98
	1-1-2		14.06	14.08	13.95	14.10	14.01
	1-1-3		14.02	14.05	14.03	13.95	14.11
1-1	Average		14.02	14.08	13.99	14.02	14.03
	1-1-4	48	14.01	14.11	14.02	14.06	14.14
	1-1-5		14.09	14.15	14.01	14.07	14.06
	1-1-6		14.10	14.05	14.02	14.01	14.00
	Average		14.07	14.10	14.02	14.05	14.07
	Initial	0			14.08		
	1-2-1	24	14.07	16.35	12.23	12.82	15.55
	1-2-2		14.11	16.60	12.01	12.73	15.99
	1-2-3		14.16	16.71	12.11	12.50	16.13
1-2	Average		14.11	16.55	12.12	12.68	15.89
	1-2-4	48	14.18	18.79	10.90	12.11	17.87
	1-2-5		14.09	18.81	11.07	12.13	18.10
	1-2-6		14.23	18.51	11.09	11.92	17.93
	Average		14.17	18.70	11.02	12.05	17.97
	Initial	0			14.02		
	1-3-1	24	13.98	14.18	13.95	13.88	14.03
	1-3-2		14.03	14.09	14.00	13.91	14.04
	1-3-3		14.03	14.20	13.83	14.01	14.11
1-3	Average		14.01	14.16	13.93	13.93	14.06
	1-3-4	48	14.08	14.11	13.93	13.87	14.09
	1-3-5		14.07	14.16	13.87	13.99	14.10
	1-3-6		14.14	14.28	13.79	13.86	14.19
	Average		14.10	14.18	13.86	13.91	14.13
	Initial	0			14.06		
	1-4-1	24	14.16	15.90	12.61	12.56	15.51
	1-4-2		14.11	16.11	12.46	12.79	15.74
	1-4-3		14.18	16.52	12.48	12.80	15.71
1-4	Average		14.15	16.18	12.52	12.72	15.65
	1-4-4	48	14.15	18.30	11.56	12.00	17.79
	1-4-5		14.09	18.63	11.22	12.01	18.02
	1-4-6		14.21	18.12	11.34	11.85	17.77
	Average		14.15	18.35	11.37	11.95	17.86
	Initial	0			13.98		
	1-5-1	24	14.05	14.18	13.87	13.88	14.09
	1-5-2		14.03	14.21	13.89	13.91	14.18
1-5	1-5-3		14.00	14.11	13.71	13.88	14.21
	Average		14.03	14.17	13.82	13.89	14.16
	1-5-4	48	14.08	14.16	13.66	13.79	14.09
	1-5-5		14.10	14.25	13.78	13.83	14.13

	1-5-6		14.17	14.12	13.80	13.84	14.19
	Average		14.12	14.18	13.75	13.82	14.14
	Initial	0			14.05		
	1-6-1	24	14.10	14.08	13.96	14.12	14.12
	1-6-2		14.03	14.12	14.02	13.98	14.07
	1-6-3		13.98	14.26	14.05	14.03	13.95
1-6	Average		14.04	14.15	14.01	14.04	14.05
	1-6-4	48	14.11	14.07	13.89	13.88	14.09
	1-6-5		14.12	14.13	13.90	14.05	14.13
	1-6-6		14.04	14.19	13.85	13.91	14.14
	Average		14.09	14.13	13.88	13.95	14.12
	Initial	0			13.99		
	1-7-1	24	13.96	14.10	14.03	13.93	14.08
	1-7-2		14.04	14.04	13.86	13.87	14.02
	1-7-3		14.03	14.09	13.90	13.83	13.98
1-7	Average		14.01	14.08	13.93	13.88	14.03
	1-7-4	48	14.01	14.06	13.82	13.98	14.13
	1-7-5		14.00	14.17	13.95	13.79	14.09
	1-7-6		14.07	14.16	13.77	13.73	14.12
	Average		14.03	14.13	13.85	13.83	14.11
	Initial	0			14.05		
	1-8-1	24	14.08	16.51	12.01	12.22	15.85
	1-8-2		14.14	16.75	12.23	12.30	16.44
	1-8-3		14.13	16.63	11.88	12.08	16.53
1-8	Average		14.12	16.63	12.04	12.20	16.27
	1-8-4	48	14.10	19.23	10.91	10.86	18.87
	1-8-5		14.19	18.98	10.83	10.95	18.66
	1-8-6		14.20	19.02	10.79	11.01	18.93
	Average		14.18	19.08	10.84	10.94	18.82

It can be seen from table 2 that the initial moisture content of each package tobacco sample after balance is not significantly different. The moisture content of each package of tobacco samples does not fluctuate significantly with the test cycle, which indicates that the tobacco sample has basically completed the balance. The range of moisture content of each fresh-keeping packaging cigarette is not large, and the range of moisture content of conventional packaging cigarette is obvious, among which 1-8# is the largest. The highest change rate of moisture content of fresh-keeping packaging cigarettes is no more than 2%, and it does not fluctuate with the test time and environmental conditions, while the change rate of moisture content of conventional packaging cigarettes shows obvious fluctuation, with the average change rate of moisture content as high as 35.78%. It can be seen that the moisture content of cigarettes in the fresh-keeping packaging can be effectively kept stable after the opening of packages, while the moisture content of cigarettes in the conventional packaging will fluctuate greatly with time and environment. T-test analysis results of samples' moisture content through paired samples after 24 h and 48h were carried out by SPSS 19 data statistical analysis tool. The probability value of t-test of each cigarette sample is greater than the significant level of 0.05, so it is considered that there is no significant change in each cigarette sample in the balanced environment, and each cigarette sample reaches the balanced level.

3.2 Influence of aluminum plastic materials and paper aluminum plastic composite materials on water retention performance

According to the design in Table 3, three groups of simulated open small box test samples (six parallel samples in each group) of soft (hard) small boxes for preservation packaging of aluminum plastic materials and paper aluminum plastic composite materials are placed in the test environment after closing and sealing, three parallel samples are taken out at 24 h interval to test the average moisture

content of each box of cigarette samples, and the results are recorded and sorted out. It can be seen from the test data that under the equilibrium condition, the moisture content of cigarettes of each simulated opened small box test sample does not fluctuate significantly with the test cycle, which indicates that the cigarette sample is basically balanced. In each test environment and cycle, the moisture content of the three groups of fresh-keeping packaging had little difference among the parallel samples, among which the moisture content of 2-3# was the largest.

Table 3 Statistical table of the cycle change of the water retention performance of the sample of fresh packaging cigarette made of aluminum-plastic material or paper-aluminum-plastic composite material under various environments

Array	Sample No.	Test interval /h	Moisture content of cigarettes in different test environment（Temperature/℃，Relative humidity/%RH）/%		
			22, 60	35, 80	35, 30
2-1	Initial	0		14.09	
	2-1-1	24	14.05	14.10	14.03
	2-1-2		13.95	14.19	14.03
	2-1-3		14.06	14.12	13.92
	Average		14.02	14.14	13.99
	2-1-4	48	14.10	14.11	14.06
	2-1-5		14.03	14.28	13.97
	2-1-6		14.06	14.21	14.02
	Average		14.06	14.20	14.02
2-2	Initial	0		14.01	
	2-2-1	24	14.00	14.05	13.98
	2-2-2		13.93	14.08	14.01
	2-2-3		14.06	14.06	14.04
	Average		14.00	14.06	14.01
	2-2-4	48	14.05	13.99	14.05
	2-2-5		14.01	14.05	14.02
	2-2-6		14.08	14.03	13.98
	Average		14.05	14.02	14.02
2-3	Initial	0		14.05	
	2-3-1	24	14.09	14.11	13.83
	2-3-2		14.02	14.29	13.97
	2-3-3		14.04	14.16	13.90
	Average		14.05	14.19	13.90
	2-3-4	48	14.07	14.18	13.76
	2-3-5		14.02	14.30	13.81
	2-3-6		14.11	14.19	13.75
	Average		14.07	14.22	13.77

The highest change range of cigarette samples in each group was no more than 2.00%, and the effect of water retention was good. In the high temperature test environment, the order of moisture content change is: 2-3＞2-1 ＞2-2 (paper aluminum plastic composite viscose soft package). The reason for the difference between the soft package and the hard package may be that there is a gap in the packaging design of the soft package viscose fresh-keeping package samples, which is directly exposed to the environment, and has a great impact on the water retention, while the hard package viscose forming design has a good sealing performance, and has the second package of the outer trademark, so the water retention performance is the best. Due to the uneven heating surface and the fold of the hot cover during the heat sealing process, the lap gap may appear, which may affect the water retention and fresh-keeping performance.

4. Conclusion

By comparing the effects of different packaging materials and packaging methods on the quality of cigarettes, the results show that: (1) after the opening of cigarette packaging, fresh-keeping packaging can effectively keep the moisture content of cigarettes stable, while the moisture content of cigarettes in conventional packaging will change in a large range with time and environment (except for balance conditions). Because of the difference of water retention, the stability of sensory quality of fresh-keeping packaging is better than that of conventional packaging. (2) the change range of moisture content of the sample in the high temperature test environment of 35 ℃: paper aluminum plastic composite viscose hard package ＞ aluminum plastic heat sealed hard package ＞ paper aluminum plastic composite viscose soft package. The differences of packaging type, material and technology will lead to the differences of water retention performance, but the differences are not obvious.

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References

[1] J.B. Zhan, H. Wang, H. Zheng, et al: IOP Conf. Series: Earth Enviro. Sci. (2019), 267042083
[2] J.B. Zhan, H. Zheng, H. Wang, et al: IOP Conf. Ser.: Earth Environ. Sci. (2019), 267042084
[3] H. Wang, H. Zheng, J.B. Zhan, et al: IOP Conf. Ser.: Earth Environ. Sci. (2019), 310032037
[4] J.B. Zhan, H. Wang, Z.H. Yu, et al: IOP Conf. Ser.: Earth Environ. Sci. (2019), 330032109
[5] Y. Wu, T. G. Liao, M. F. Wang, et al: Tobacco Sci. Tech., Vol.5(2015), p. 80
[6] H. Klus, G. Scherer, L. Müller: Beitr Tabakforsch Int., Vol. 25(2012), p. 411.
[7] N. Djulancic, V. Radojicic, M. Srbinoska, et al: Int. Sci. Agri. Food Ind., Vol. 4(2013), p.110.
[8] D.E.Townsend: Washington DC: 37th TRC Conference, (1983)C1, p.56.