Comparison and Analysis of Important Product Standards and Technical Indicator Systems in the Papermaking Field-Taking Facial Tissue as An Example

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Abstract. This article summarizes the current status of domestic and foreign standards for paper products and the standard system, compares and analyzes the domestic and international standards for facial tissue which is key product in the papermaking industry, combines the production technology, characteristics, and requirements of the product to establish key technologies index list for facial tissue, carries on comprehensive analysis of product standard index levels, testing methods, etc., and gives opinions and suggestions on product standard formulation and revision.

1. Introduction

Papermaking, a basic industry of raw materials, is one of the important pillar industries in national economy.[1] Paper and paperboard are main products of the papermaking industry, mainly including printing paper, cultural paper and office paper, packaging paper, technical paper, household paper.[2] As an important consumer product for daily use, paper products (such as facial tissue, toilet paper, paper diaper, sanitary pad, and copy paper) are closely concerned with people’s daily life. With the continuously enhancement of people’s standards of consumption and safety awareness, the consumption of paper products attracts more attention and shows an increasing trend year by year. Since the implement of the Plan for Deepening the Reform of Standardization Work in 2015, China has successively released a series of important standard documents to put forward the standard comparison and analysis requirements for product quality improvement and brand building. The report of the 19th National Congress of the CPC pointed out that we need to deepen the supply-side structural reform and make improvement according to international standards. The Guiding Opinions of Implementing the Quality Improvement Action issued by the CPC Central Committee and the State Council proposed to “speed up the upgrading of standards and implement the enterprise standard forerunner system”. The state has launched a special action for over ten thousand of enterprises from thousands of industries in hundreds of cities[3] and opinions on the implementation of enterprise standard “forerunner” system[4] for the purpose of actively carrying out the comparative evaluation of standards, giving full play to the fundamental, guiding and strategic role of standardization in quality improvement, improving product quality, and enhancing the quality of industrial development.

2. Domestic and foreign standards for paper products and the current status of the standards systems
2.1 Standards for Paper Products in China

After years of system construction, a standard system in which mandatory standards match recommended standards, national standards, industry standards complement each other, and basic standards combine specific product standard at levels has been built for the paper products industry. The National Paper Industry Standardization Technical Committee (TC141) is responsible for standardized technology of paper products in China. By the end of 2019, there were 468 existing standards in the paper industry, including 348 national standards and 120 industrial standards; by standard property: there were 1 mandatory standards, 467 recommended standards.

2.2 Standards for Paper Products in Foreign Countries

The following contents focus on the standard management systems, standardization mechanisms and standard system construction of the International Organization for Standardization (ISO), EU, Germany, the United Kingdom and Japan. [5] [6]

(1) ISO international standard

The ISO/TC6 “Technical Committee on Paper, Paperboard and Pulp” is an ISO organization responsible for developing relevant international standards concerning test methods and quality specifications of paper, paperboard and pulp, and its subordinate paper and paperboard technical sub-committees (ISO/TC6/SC2) are responsible for the preparation and revision of relevant test methods and standards for paper and paperboard. The ISO/TC6 is responsible for the standards of the general test method and pulp test method. The ISO/TC6 standard system consists of three parts: standards for basic general method, standards for paper and paperboard test method, and standards for pulp test method. At present, ISO/TC6 has a total of 177 papermaking standards, including 2 technical guidance documents. The standards formulated by ISO/TC6 mainly focus on testing methods. Most standards for papermaking test methods in China are formulated in compliance with ISO standards.

(2) European Union (EU)

The EU standard management system is composed of EU technical regulations, new approach directives, EU coordinative criteria and EU conformity assessment procedures. EU directives are about “basic requirements”, namely, basic health and safety requirements that must be met before the product is put on the market. The task of the European standardization institution, on the other hand, is to develop corresponding technical specifications (namely the “coordinative criteria”) that meet the basic requirements of the directives. When a product complies with these technical specifications, it can be determined that the product meets the basic requirements of the directives. According to EU regulations, all products covered by the new approach directives related to safety, hygiene, health and environmental protection must go through the corresponding conformity assessment procedures to get a CE mark before entering the EU market. A product with a CE mark on it indicates that the product complies with the basic safety, hygiene, health or environmental protection requirements stipulated in EU new approach directives and can be bought or sold freely in the EU market. At present, the relevant directives and resolutions involved include: REACH Regulations, and Eco-Label Requirements of EU Directive for Absorbent Hygiene Products (2014/763/EC) and Tissue paper (2009/568/EC).

(3) The United Kingdom (UK)

In the UK’s standard management system, the Standard and Technical Regulation Division of the Department of Trade and Industry is the competent department in charge of standard establishment, test and certification of policies at the policy level. Specific standard, test, and certification management functions are performed by two government agencies: The standard management function is performed by the British Standards Institution (BSI), and the test and certification management functions are performed by the United Kingdom Accreditation Service. BSI is managing 240,000 existing British standards and 2,500 professional standards committees, with more than 230,000 standard committee members. In addition, thousands of standard projects are being developed by BSI each year. In terms of the standards for children’s paper, the BSI mainly focuses on test method standards, with a small number of product standards. ISO standards are directly taken by countries as their national test method standards in most cases.

(4) Germany

Germany implements a non-governmental standardized management system authorized by the
government. The government does not directly interfere in the operation of the country’s overall economy. Deutsche Industrie-Norm (DIN) is a non-profit private organization founded in 1917. According to the agreement signed with the federal government of Germany, the DIN is a standardization competent authority which represents Germany in international and European standardization activities and manages domestic standardization activities, including the formulation and revision of standards. DIN standards are voluntary standards. When formulating standards, relevant interested parties shall determine whether to formulate relevant standards according to the market demand, with enterprises that master advanced technology playing the dominant role. Based on extensive participation by scientific research institutions, governments, individuals, the formulation of standards shall adhere to the principle of openness and transparency. Most standard committee members should be enterprises, and they shall put forward the need for developing standards and bear most of the cost derived from research and standard formulation. In German, all standards, technical regulations, technical rules, technical procedures, and technical specifications are collectively referred to as technical specification documents, and they are divided into three levels: DIN standards, technical rules, and technical regulations. German DIN Group owns German Conformity Assessment Company, DQS, European Certification Company and other famous certification organizations. In the field of children’s paper, similar to the UK’s standards, German standards also focus on test methods. The test method standards released by ISO or EN are directly taken as German standards.

(5) Japan
In Japan’s standard management system, the Ministry of Economy, Trade and Industry (former Ministry of International Trade and Industry) is responsible for the formulation, revision, promulgation of industrial standardization regulations in addition to related administrative management. The specific work is carried out by the Japan Industrial Standards Committee (JISC). The draft of Japanese industrial standards (JIS) is proposed by the competent minister or non-governmental organizations and reviewed and published by the JISC. JIS standards developed accordingly are Japan’s national standards. The Ministry of Health, Labor and Welfare (MHLW) is a ministry of the Japanese government. In the field of health, the Ministry of Health, Labor and Welfare of Japan has equivalent functions of some departments in China, including the National Health Commission, China Food and Drug Administration, National Development and Reform Commission (medical services and drug price control), Ministry of Human Resources and Social Security (medical insurance), Ministry of Civil Affairs (medical assistance), General Administration of Quality Supervision, Inspection and Quarantine (frontier sanitary quarantine). The Ministry of Health, Labor and Welfare of Japan including the Health Administration and Medical & Food Administration, is responsible for the national administration of food, drugs, cosmetics, medical devices and biological preparations, including the formulation of standards for these products.

(6) The United States (US)
With American National Standard Institute (ANSI) as the coordinating body, the American standards system consists of three parts: the national standards system, federal government standards system, and professional standards system of professional groups. In the United States, it is considered that mandatory standards may inhibit the improvement of productivity. Standards that are cited by law and formulated by government departments, however, are generally mandatory standards. The standards developed by the Technical Association of the Pulp and Paper Industry (TAPPI) have become general standards recognized globally in the paper industry. TAPPI standards involves six parts: fibrous material and pulp test, paper and paperboard test, non-fibrous material test, packaging container test, building material test, and test procedures. Currently, there are 234 standards. The association has developed standards only for test methods other than product standards.

3. Comparative analysis of the standards for facial tissues and paper products at home and abroad

3.1 Domestic and Foreign Standards
Facial tissues are a kind of disposable sanitary paper made from plant fibers and processed by slitting and folding, and they are water-absorbing, soft, clean and convenient to use. Facial tissues mainly
include: paper tissues, paper towels, and paper napkins. They are widely used in restaurants, at tables, in families or used as carry-on personal belongings. As facial tissues have become one of the necessities in people's life, the quality and standard of facial tissues attract extensive attention. [7][8]

In the comparison of facial tissue standards, a total of 4 national standards in Chinese mainland and Taiwan Province are selected, involving EU’s REACH regulations and facial tissue standards of other 4 countries (the United Kingdom, the United States, Canada, and South Africa). Table 1 shows 4 facial tissue standards in Chinese mainland and Taiwan Province. Table 2 shows 7 facial tissue regulations and standards in foreign countries.

| No. | Standard, Regulation Number and Title | Remarks |
|-----|--------------------------------------|---------|
| 1   | GB/T 20808-2011 Facial Tissue        | National standard |
| 2   | GB 15979-2002 Hygienic Standard for Disposable Sanitary Products | National standard |
| 3   | CNS 2386-2014 Paper Napkin           | Standard in Taiwan Province |
| 4   | CNS 4150-2014 Facial Paper           | Standard in Taiwan Province |

| No. | Standard, Regulation Number and Title | Remarks |
|-----|--------------------------------------|---------|
| 1   | REACH Regulations                    | EU      |
| 2   | BS 1439-1992 Specification for Single-Ply Wet-Creped Paper Toweling | The UK  |
| 3   | DOD MIL-T-37968-1986 Tissue (for Dentistry) | the US  |
| 4   | CGSB-9.4-94 Facial Paper for Public Use | Canada |
| 5   | SANS 1887-3: 2008 Facial Paper       | South Africa |
| 6   | SANS 1887-4: 2008 Tissue             | South Africa |
| 7   | SANS 1887-7: 2008 Paper Napkin       | South Africa |

3.2 Comparative Analysis on Safety Indicators of Facial tissue Standards in China and Foreign Countries

3.2.1 Safety Requirements in Domestic Facial Tissue Standards. For Chinese facial tissue standards, the safety indicators mainly refer to raw materials, chemical safety and hygiene safety:
(1) Raw materials
GB/T 20808-2011 Facial Tissue clearly stipulates that making facial tissues from toxic and hazardous materials is prohibited. Instead, virgin fibrous materials such as wood, grass, bamboo should be used. Making facial tissues from any recycled paper, printed matter, paper product and other recycled fibrous material is prohibited. The application of deinking agent is prohibited.

The current CNS 2386-2014 Paper Napkin (Taiwan) stipulates that 100% virgin chemical pulp or pulp mixed with part of virgin mechanical wood pulp shall be used as raw materials; the current CNS 4150-2014 Facial Paper stipulates that the raw materials shall be 100% virgin pulp.

(2) Chemical safety
In order to ensure the product performance or meet the need for process control during the production of facial tissues, decolorizer may be used in the pulping process. Some companies even add fluorescent brightener to make tissue whiter. To cope with this problem, GB/T 20808-2011 stipulates that the detection of migrating fluorescent brightener is not acceptable. Moreover, GB/T 20808-2011 Facial Tissue has regulated the ash contents: wood fiber ≤1.0%, wood fiber ≤4.0%. The control over ash indicators can directly restrain the adding of a large amount of materials, which avoids the shedding of
powder and indirectly limits the use of secondary fibers in facial tissues. When making facial tissues, we need to add some chemicals such as softening agent, wet-strength agent. Therefore, chemical residues in finished paper may pose a risk for safe use. However, there is no existing specified standard for acrylamide. CNS 2386-2014 *Paper Napkin* (Taiwan) and CNS 4150-2014 *Facial Paper* (Taiwan) stipulate that products shall not contain migrating fluorescent substances, and the chemicals, pigments and dyes used shall comply with relevant health regulations.

(3) Hygiene safety

GB/T 20808-2011 *Facial Tissue* also stipulate that hygienic indexes of facial tissue (aerobic bacterial count, colon bacillus, pseudomonas aeruginosa, staphylococcus aureus, hemolytic streptococcus, fungal count) shall meet the requirements of GB 15979-2002 *Hygienic Standards for Disposable Sanitary Products*. According to the requirements, the aerobic bacterial count in facial tissue products shall be less than and equal to 200 cfu/g, the fungal count shall be less than and equal to 200 cfu/g, and coliform bacteria and pathogenic pyogenic bacteria (pseudomonas aeruginosa, staphylococcus aureus and hemolytic streptococcus) shall not be detected.

3.2.2 Safety Requirements in Foreign Facial Tissue Standards. EU: Safety indicators related to facial tissue in REACH Regulations include: The content concentration of acrylamide shall be less than and equal to 0.1%; the mass fraction of nonyl phenol and nonylphenol polyoxyethylene ether shall be less than and equal to 0.1%.

The UK: BS 1439-1992 *Specification for Single-Ply Wet-Creped Paper Toweling* stipulates that wet crepe wipes should be free of fluff or fiber, and the pH value of dye residues in the hands shall range from 4 to 10 after use.

The US: DOD MIL-T-37968-1986 *Tissue (for Dentistry)* stipulates that facial tissues shall be made from 100% bleached wood pulp.

Canada: CGSB-9.4-94 *Facial Paper for Public Use* stipulates that tissue paper can be made from virgin pulp or recycled pulp.

South Africa: SANS 1887-3: 2008 *Facial Paper* stipulates that facial paper shall be made from processed cellulosic fiber with a pH value ranging from 4.4 to 10.0; SANS 1887-4: 2008 *Tissue* stipulates that tissue paper shall have a pH value ranging from 4.4 to 10.0; SANS 1887-7: 2008 *Paper Napkin* stipulates that paper napkins shall be made from processed cellulosic fiber with a pH value ranging from 4.4 to 10.0.

3.2.3 Comparison Analysis of Facial Tissue Safety Indicators. In terms of raw materials, China’s national standard GB/T 20808-2011 *Facial Tissue*, CNS 2386-2014 *Paper Napkin* (Taiwan) and CNS 4150-2014 *Facial Paper* (Taiwan), the US’s DOD MIL-T-37968-1986 *Tissue* (for Dentistry) have strict requirements for raw materials, that is, 100% virgin fibrous materials shall be used as raw materials. Canada’s CGSB-9.4-94 *Facial Paper for Public Use* stipulates that facial paper can be made from virgin pulp or recycled pulp. China has a stricter requirement for raw materials than that of Canada.

In terms of chemical safety, China’s facial tissue standard stipulates that the detection of migrating fluorescent brighteners and the application of deinking agent are prohibited. The standards of Taiwan stipulate that the product shall not contain migrating fluorescent brighteners, and the chemicals, pigments and dyes used shall comply with relevant health regulations. The UK’s facial tissue standard stipulates that the dye shall not remain in the hands when facial tissue is used. South Africa’s standard stipulates the pH range of facial tissue. The EU’s REACH Regulations stipulate the limits of acrylamide, nonylphenol and nonylphenol polyoxyethylene ether, while the limits of these substances have not been included in China’s standard at present.

In terms of hygienic safety, China’s GB/T 20808-2011 *Facial Tissue* stipulates that hygienic indicators of facial tissue shall meet the requirements of GB 15979-2002 *Hygienic Standard for Disposable Sanitary Products*. In other countries, hygienic indexes are not included in standards for facial tissues.

3.3 Comparison and Analysis of the Indicators for Physical Properties of Facial Tissue in Domestic and International Standards
3.3.1 Indicators for Physical Properties of Facial Tissue in Domestic Standards. The indicators for physical properties in the GB/T 20808-2011 Facial Tissue in China mainly include brightness, tensile index (CD), wet tensile strength (MD), capillary rise (CD), and softness. Table 3 gives the details.

Table 3. Major indicators for physical properties in GB/T 20808-2011 Facial Tissue

| Indicator                      | Unit          | Provision       | Testing method   |
|--------------------------------|---------------|-----------------|------------------|
|                                |               | Superior        |                  |
|                                |               | Super soft      | Ordin ary        |
|                                |               | Qualified       |                  |
| Brightness                     | %             | ≤90.0           | GB/T 7974        |
| Tensile index (CD)             | N.m/g         | ≥1.0 ≥2.10 ≥1.50| GB/T 12914-2008  |
| Wet tensile strength (MD)      | N/m           | ≥10.0 ≥14.0 ≥10.0| GB/T 12914-2008  |
| Capillary rise (CD)            | mm/100s       | ≥20 ≥15         | GB/T 461.1       |
|                                | Single-ply    |                |                  |
|                                | Double-ply or multi-ply | ≥40 ≥30 |                  |
| Average softness of MD and CD  | mN            | ≤40 ≤85 ≤160    | GB/T 8942        |
|                                | Single-ply or double-ply |   |                  |
|                                | Multi-ply     | ≤80 ≤150 ≤220   |                  |

According to CNS 2386-2014 Paper Napkin (Taiwan): size tolerance: ±5%, color be: ≥75%, and quantification (single-ply): ≤30g/m². According to CNS 4150-2014 Facial Tissue (Taiwan): size tolerance: ±5%, quantification (single-ply): more than 12.0g/m², tensile strength (CD, double-ply): ≥80gf/25mm, wet tensile strength (MD, double-ply): ≥23.5N/m, and water absorbency in the first minute (single-ply): ≥12mm.

3.3.2 Indicators for Physical Properties of Facial Tissue in International Standards. The relevant standards of the UK, South Africa, Canada and the US have provisions on the indicators for physical properties of facial tissue:

(1) The quality indicators specified in the BS 1439-1992 Specification for Single-ply Wet-creped Paper Toweling include: size (the area of each individual towel shall be not less than 645cm², and in no case shall the dimension of the shorter edge of each sheet of toweling be less than 20.3cm); wet tensile strength: ≥1.8N/15mm; rate of absorbency: ≤30s/0.02ml.

(2) According to the DOD MIL-T-37968 Towel, Paper (Dental) in the US: bursting strength of towel (12-ply): ≥15points, quantification (500-ply, 24×36 IN): ≥10.5lbs, water absorbency: ≤10s, brightness: 80%, and wet tensile strength (CD ≥0.5kg, MD ≥0.7kg).

(3) The CGSB-9.4-94 Facial Tissue for Institutional Use in Canada has provisions on dry tensile strength (average of MD and CD for single-ply ≥40N/m), wet tensile strength (average of MD and CD for single-ply ≥6N/m), and water absorbency (≤20s).

(4) The indicators specified in the SANS 1887-3: 2008 Facial Tissue in South Africa mainly include: quantification, dry tensile strength (average of MD and CD): ≥93N/m, softness: ≤120mN, and brightness: ≥78%.

The indicators specified in the SANS 1887-4:2008 Tissue mainly include: quantification, water absorption rate: ≤50%, total water absorption (single-ply ≥180%, double-ply ≥250%), dry tensile strength (MD ≥350N/m, CD ≥160 N/m), and softness: ≤300mN.

The indicators specified in the SANS 1887-7:2008 Paper Napkin mainly include: quantification, water absorption rate (type 1 ≤75s; type 2 ≤10s; type 3 ≥300s), total water absorption (≥180%), dry tensile strength (type 1: CD ≥53N/m, average of MD and CD ≥107 N/m; type 2: CD ≥33 N/m, average of MD
and CD $\geq 67N/m$; type 3: $CD \geq 67N/m$, average of MD and CD $\geq 120N/m$), softness (type 1 $\leq 275mN$; type 2 $\leq 145mN$; type 3 $\geq 390mN$), and brightness $\geq 68\%$.

### 3.3.3 Comparison Analysis of the Indicators for Physical Properties of Facial Tissue in Domestic and International Standards

The indicators for physical properties of facial tissue are mainly strength, water absorbency, and softening property. The strength, water absorbency and softening property of facial tissue are mainly compared and analyzed this time, as shown in Table 4, Table 5 and Table 6, respectively.

(1) **Strength**

### Table 4. Comparison of strength of facial tissue

| Country   | Standard No. and Title | Wet tensile strength or index | Dry tensile strength (bursting strength) |
|-----------|------------------------|-------------------------------|-----------------------------------------|
| China     | GB/T 20808-2011 Facial Tissue | Qualified $\geq 10.0N/m$, Superior (ordinary) $\geq 14.0N/m$, Superior (supersoft) $\geq 10.0N/m$ | Tensile index (CD) Qualified $\geq 1.50 N.m/g$, Superior (ordinary) $\geq 2.10 N.m/g$ Superior (supersoft) $1.00N.m/g$ |
| Taiwan    | CNS4150-2014 Facial Tissue | Wet tensile strength (MD, double-ply) $\geq 23.5N/m$ | Tensile strength (CD, double-ply) $\geq 3.14 N/m$ |
| The UK    | BS 1439-1992 Specification for Single-ply Wet-creped Paper Toweling | Wet tensile strength $\geq 12N/m$ | Unspecified |
| Canada    | CGSB 9.4-94 Facial Paper for Public Use | Wet tensile strength (average of MD and CD for single-ply $\geq 6N/m$) | Average of MD and CD for single-ply $\geq 40N/m$ |
| South Africa | SANS 1887-3: 2008 Facial Paper | Unspecified | Average of MD and CD 93N/m |
|           | SANS 1887-4: 2008 Tissue | Unspecified | MD $\geq 350 N/m$ CD $\geq 160 N/m$ |
|           | SANS 1887-7: 2008 Paper Napkin | Unspecified | Type 1: $CD \geq 53N/m$, average of MD and CD $\geq 107 N/m$, type 2: $CD \geq 33 N/m$, average of MD and CD $\geq 67 N/m$, type 3: $CD \geq 67 N/m$, average of MD and CD $\geq 120 N/m$ |
| the US    | DOD MIL-T-37968-1986 Tissue (for Dentistry) | $CD \geq 0.5kg$ Average of MD and CD $\geq 0.7kg$ | Bursting strength (12-ply $\geq 15$points) |

The wet tensile strength (MD) is an important indicator to reflect the wet strength of facial tissue. Because the facial tissue will contact with water or sweat when they are used, the tissue should have a certain wet strength, which can avoid the phenomenon of cracking, dry linting and paper dust & fluff when wet. According to the national standard of China, the wet tensile strength (MD) of the qualified
for facial tissue shall be larger than and equal to 10.0N/m, that of the superior (ordinary) shall be larger than and equal to 14.0N/m, and that of the superior (supersoft) shall be larger than and equal to 10.0N/m; according to the Canadian standard, the average wet tensile strength of MD and CD (single-ply) shall be larger than and equal to 6N/m; according to the standard of the UK, the wet tensile strength shall be larger than and equal to 12N/m; according to the standard in Taiwan, the wet tensile strength (MD, double-ply) shall be larger than and equal to 23.5 N/m. According to the US standard, the wet tensile strength (CD) shall be larger than and equal to 0.5kg, and the average of MD and CD shall be larger than and equal to 0.7kg. On the whole, all countries have provisions on the indicator for wet tensile strength. Due to differences in testing methods, it is not easy to judge the indicator value, but the indicator level is basically the same.

Moreover, it is stipulated in the national standard of China, the tensile index (CD) of the qualified for facial tissue shall be larger than and equal to 1.50 N·m/g, that of the superior (ordinary) shall be larger than and equal to 2.10 N·m/g, and that of the superior (supersoft) shall be 1.00N·m/g; the standards in Taiwan, Canada and South Africa do not define the tensile index (CD), but instead specify the tensile strength (CD). The US standard provides for the bursting strength.

(2) Water Absorbency

**Table 5. Comparison of water absorbency of facial tissue**

| Country     | Standard No. and Title                                                                 | Capillary rise (CD)                                                                 | Others                                                                 |
|-------------|---------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-----------------------------------------------------------------------|
| China       | GB/T 20808-2011 *Facial Tissue*                                                      | Qualified: Single-ply ≥15mm/100s, double-ply or multi-ply ≥30mm/100s Superior: Single-ply ≥20mm/100s, double-ply or multi-ply ≥40mm/100s | Unspecified                                                          |
| The UK      | BS 1439-1992 *Specification for Single-ply Wet-creped Paper Toweling*               | Unspecified                                                                         | Total absorbency ≥0.93g, rate of absorbency ≤30s/0.02ml               |
| Canada      | CGSB-9.4-94 *Facial Paper for Public Use*                                           | Unspecified                                                                         | Water absorbency ≤20s                                                |
| South Africa| SANS 1887-4: 2008 *Tissue*                                                           | Unspecified                                                                         | Water absorption rate (≤50s), total water absorption ≥180% for single-ply, ≥250% for double-ply |
|             | SANS 1887-7: 2008 *Paper Napkin*                                                      | Unspecified                                                                         | Total water absorption ≥180% Water absorption rate: type 1: ≤75s, type 2: ≤10s, type 3: ≥300s |
| the US      | DOD MIL-T-37968-1986 *Tissue (for Dentistry)*                                        | Unspecified                                                                         | Water absorbency: ≤10s                                              |
| Taiwan      | CNS 4150-2014 *Facial Paper*                                                         | Water absorbency in the first minute (single-ply): ≥12mm                          | -                                                                   |
Capillary rise (CD) is to measure the capillary rise within 100s, which reflects the water absorbency of tissue. In the Chinese standards, the indicator for water absorbency of facial tissue is mainly capillary rise (CD). In international standards, water absorbency, total water absorption, water absorption rate, and other indicators are mainly specified. The standards in Taiwan stipulate the capillary rise in the first minute. Due to differences in testing methods and time, it is impossible to determine the level of the set indicator value.

(3) Softening Property

| Table 6. Comparison of softening property |
|--------------------------------------------------|
| **Country** | **Standard No. and Title** | **Softness** |
| China | GB/T 20808-2011 *Facial Tissue* | Qualified: Single-ply or double-ply products ≤160mN, multi-ply products ≤220mN. Superior: (ordinary) Single-ply or double-ply products ≤85mN, multi-ply products ≤150mN. (supersoft) Single-ply or double-ply products ≤40mN, multi-ply products ≤80mN |
| The UK | BS 1439-1992 Specification for Single-ply Wet-creped Paper Toweling | Unspecified |
| Canada | CGSB-9.4-94 *Facial Paper for Public Use* | Unspecified |
| South Africa | SANS 1887-3: 2008 *Facial Paper* | Softness ≤120mN |
| | SANS 1887-4: 2008 *Tissue Napkin* | Softness ≤300mN |
| | SANS 1887-7: 2008 *Paper Napkin* | Softness: type 1 ≤275 mN, type 2 ≤145 mN, type 3 ≥390mN |
| the US | DOD MIL-T-37968-1986 *Tissue (for Dentistry)* | Unspecified |
| Taiwan | CNS 2386-1987 *Paper Napkin* | Unspecified |
| CNS 4150-2008 *Facial Tissue* | Unspecified |

Softness is also an important technical indicator of facial tissue, which reflects the softening property of facial tissue. Softening property is the most direct feeling of consumers when using facial tissue. The softening property of facial tissue in the Chinese standard is mainly measured by the softness. Compared with the standard for softness in South Africa, its classification of facial tissue is more explicit, so the requirements for softness are relatively more complete. The standards for facial tissue in the UK, Canada, the US, Korea, and Taiwan have no provisions on the softness. Furthermore, the standards in China for facial tissue and products thereof have also limited the brightness, while those in other countries have no provisions on the brightness.

4. Conclusion

Upon comparison and analysis of domestic and international standards for facial tissue, we get some conclusions.

In terms of the indicators for hygienic safety, the GB 15979-2002 *Hygienic Standard for Disposable Sanitary Products* is implemented for facial tissue in China, which is more stringent than that in other countries.

In terms of the provisions on chemical safety, according to the Chinese standard for facial tissue, no chemical substances such as deinking agents, fluorescent brighteners and the like can be used in the production process. However, the REACH regulations in the EU have limited the amount of acrylamide,
nonylphenol, and NPE. Therefore, the regulations on the addition of harmful chemical substances such as acrylamide need to be further completed in the standards for facial tissue in China. In terms of raw materials, according to the Chinese standard, no toxic and harmful raw materials shall be used for facial tissue, but virgin fiber materials such as wood, grass, and bamboo shall be used, and raw materials cannot be recycled paper, paper prints, paper products, and other recycled fibrous materials. However, according to the Canadian standard, the raw materials can be virgin pulp or recycled pulp. Therefore, China has stricter requirements on raw materials of facial tissue.

In terms of physical properties, there are differences in indicator names, testing methods, and expression methods of results in the standards of different countries, which are not comparable. On the whole, they are basically the same. The Chinese standards have provisions on the grade and plies of the products, which are more detailed and complete.

The following suggestions are proposed:

(1) Efforts shall be made to complete the technical contents of the product standards in China based on the comparison analysis conclusions, such as supplementing acrylamide, heavy metals and other safety indicators in facial tissue, so as to further improve the applicability of the standards and product quality level, thus protecting the health and safety of consumers.

(2) The quality safety of raw materials is closely related to the finished products. Strengthening the formulation of the standard for raw materials can ensure the safety of finished products. In addition, efforts shall be made to study and develop the standards for testing method of harmful chemical substances and the indicators for product comfort in paper products, and improve the safety and comfort of domestic diaper products by completing standard methods.

(3) Production enterprises should strengthen the management and control over the life cycle including raw materials and production process from the source, establish a raw material acceptance and traceability system, improve process conditions, and eliminate product safety risks as much as possible[9][10]. They should benchmark against the most stringent standards actively to establish their own enterprise standards and improve the product quality with high standards.

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