滑石粉在塗佈紙的應用

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The Application of Talc on Paper Coating

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Abstract

In 1982, talc was first applied to use as a paper coating pigment. Currently, it is widely used in the Far East and European countries for coating LWC paper for rotogravure and for coating matted art paper and special coated paper for offset printings. Based on differences in the ores and the main compositions, talc can be obtained from 4 types of derivative ore bodies, viz., magnesium carbonate, serpentine, silica aluminous rock, and magnesium sedimentary deposit. Chemical composition of talc is Mg3(Si4O10)(OH)2, and it possesses a flaky appearance, each flake is composed of a SiO2-Mg(OH)-SiO2 layers with van der Waal forces holding inter-ply strata. Because of the weak bonding, talc defoliates easily during diminution processes whence it exhibits a slippery characteristic and the lubrication effect in coating color formulation. The silica layer surfaces have hydrophobic and lipophilic nature, while the edges of the plates are hydrophilic. The manufacturing process units of the talc consist of ore selection, sorting and diminution and slurry forming. The commercial talc diminution processes include dry- and wet-milling 2 types.

Talc-containing coated paper for rotogravure printing often has good machine runnability during coating and the low-frictional coefficient of the talc ensures that paper rolls have good rewinding characteristics, lowering the occurrences of wrinkles in winding, and improve printing operation efficiency. Talc powders can provide good fiber hiding capability, hence improve printing quality. When matted art paper coated with talc is used for offset printing, abrasiveness of the paper surface and printing ink rub-off tendencies are lowered, and at the same time, ink holdout and printed opacity can be improved. Using coarser talc particles can achieve the matted effect while maintaining high surface smoothness of the coated paper. The hydrophobic and flaky natures of the talc render it suitable for use in certain specialty coated paper, such as paperboard, wall papers, label papers etc. to replace PE laminate as a barrier coating. When applied to wall paper coating, it can also improve water wash capacity of the wall paper. When serving as a undercoats, it can provide barrier properties to lower the rates of penetration of water and water-soluble substances. When applied as surface coating on label papers, it has good printability in both rotogravure and offset printings, and prevents sticking together of stacked label papers, hence improve the operation of labeling.

前言

滑石粉應用在造紙業的歷史相當早，20 世紀初在法國、意大利、西班牙、芬蘭、日本等地區，已有滑石粉在濕端作爲填料應用的報導 [1-3]。1958 年，Lamar 指出超細(ultrafine)滑石粉的粒徑分佈已適合應用在塗佈作業 [4]。1960 年，Maurice Warner (Cyprus Minerals)利用高純度滑石粉作爲樹脂控制應用 [1]。隨著製程技術的進步，1982 年在芬蘭及法國地區，首先引進滑石粉作爲塗佈紙顏料的應用。目前滑石粉在遠東地區及歐洲地區(特別是芬蘭地區)，已廣泛應用在凹版印刷(gravure)用 LWC 塗佈紙及柯色版印刷(offset)用雪面銅版紙的塗佈配方中 [1,2]；但是在北美洲地區，並不多見 [3]。近年來更有滑石粉應用在特殊塗佈紙的報導 [1]。

滑石粉礦爲含有MgO、SiO_2、CO_2等成份的礦石，經由水熱化作用(hydrothermal activity)轉化沉積而成。天然滑石粉以層狀(foliated)及緊密團聚(mass compact)狀兩種型態存在，緊密團聚型態有時稱爲塊滑石(steatite)或火山石滑石(lava talc)[3]。因爲礦石所含主成份的不同，會決定滑石粉原礦的基本性質。世界滑石粉礦源依主成份的不同，可以分類成四種型態來討論 [1]：

1. 碳酸鎂衍生礦(magnesium carbonate erivative ore bodies)

此礦源約佔世界滑石粉產量的 70%，原礦通常爲質純且色白。在中國、遠東地區、及大部份歐洲大陸的滑石粉礦均屬於此型態。

2. 蛇形石衍生礦 (serpentine derivative ore bodies)

此礦源約佔世界滑石粉產量的 20%，分散在世界各地。原礦通常爲灰色且純度不高，不適合直接使用在造紙塗佈應用。通常利用多段浮選純化法來提高滑石粉含量及白度，以達到造紙塗佈應用的規範。在歐洲及北美洲有相當比例的塗佈級滑石粉來自此型態。

3. 硅鋁礦石衍生礦 (silica aluminous rock derivative ore bodies)

此礦源約佔世界滑石粉產量的 10%，通常與碳酸鎂衍生礦所共生。原礦因與綠泥石(chlorite)共生，所以呈灰色。綠泥石與滑石粉的性質類似，有時調控綠泥石與滑石粉比例，以達到特殊的塗佈紙性質。

4. 鎂沉積衍生礦 (magnesium sedimentary deposit derivative ore bodies)

此礦源目前並沒有被開發，原礦通常爲滑石粉與石英砂(quartz)的混合物，有時與雲母、白土、氧化鐵及有機物摻雜在一起。

塗料級滑石粉在亞洲地區以碳酸鎂衍生礦爲主，而歐洲及北美洲地區則以蛇形石衍生礦及硅鋁礦石衍生礦爲大宗。目前世界的滑石粉年產量約在 500 萬噸，1998 年各地區的滑石粉產量說明於表 1。