Effects of structures of metatitanic acid on the preparation of high purity titanium dioxide via Sulfate Process

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The composition and structure of industrial metatitanic acid played a decisive role on the crystal structure of titanium dioxide, affecting the purity of titanium dioxide. High purity titanium dioxide was prepared from low concentration industrial titanyl sulfate by Sulfate Process. The effects of preadding water volume ratio, aging time, total TiO₂ concentration on the particle size distribution, crystal size and titanium dioxide content of metatitanic acid were investigated. The preadding water volume ratio determined the concentration, quantity and activity of the hydrolysis seeds, affected the integrity of metatitanic acid particles and cell parameters, which had important impacts on the purity of titanium dioxide. The aging time and total titanium concentration affected the particle size distribution of metatitanic acid, the purity of titanium dioxide. The optimum conditions were that the preadding water content was of 60%, the aging time was of 20 min, and the total TiO₂ concentration was of 180.4 g/L, the particle size distribution was narrowest and the grain size was relatively smaller, and the purity of titanium dioxide was the highest, with TiO₂ content of 99.98%.

Fig.1 XRD patterns for high purity metatitanic acid

Fig.2 XRD patterns for rutile high purity TiO₂

Table 1 Effects of preadding water volume ratio on the purity and particle size distribution of TiO₂

Sample	Preadding water volume ratio/%	TiO ₂ content /%	D ₁₀ /μm	D ₅₀ /μm	D ₉₀ /μm	D _{av} /μm
DT1#	20	99.94	0.07	0.17	0.57	0.25
DT2#	30	99.85	0.07	0.16	0.54	0.24
DT3#	40	99.65	0.06	0.15	0.47	0.22
DT4#	50	99.95	3.54	7.84	15.03	8.70
DT5#	60	99.98	3.74	7.27	13.33	8.03
DT6#	80	99.92	5.70	11.82	20.82	12.74
DT7#	/	99.90	0.07	0.25	0.83	0.37

Table 2 Effects of preadding water volume ratio on the particle size distribution of metatitanic acid

Sample	Preadding water volume ratio/%	D ₁₀ /μm	D ₅₀ /μm	D ₉₀ /μm	D _{av} /μm
DP1#	20%	0.52	1.02	2.03	1.18
DP2#	30%	0.57	1.01	1.78	1.11
DP3#	40%	0.55	0.95	1.63	1.04
DP4#	50%	5.26	11.84	21.11	12.71
DP5#	60%	5.22	10.55	18.90	11.49
DP6#	80%	8.06	16.38	26.13	16.89
DP7#	/	0.57	1.08	1.99	1.21

Table 3 Effects of aging time on the purity and particle size distribution of TiO₂

Sample	Aging time /min	TiO ₂ content /%	D ₁₀ /μm	D ₅₀ /μm	D ₉₀ /μm	D _{av} /μm
ST1#	0	99.77	4.92	9.37	16.89	10.28
ST2#	10	99.97	4.97	9.40	16.93	10.32
ST3#	20	99.97	0.55	5.67	14.62	6.80
ST4#	25	99.97	2.81	8.43	17.29	9.41
ST5#	30	99.64	2.63	8.35	17.18	9.30
ST6#	35	99.92	2.45	8.13	17.02	9.10
ST7#	40	99.94	2.47	8.10	17.15	9.12