

MSDS

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1) . 2)

A Study on the Chemical Composition and MSDS Reliability of Powder Coatings

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As a result of having examined reliability of MSDS record contents about powder coatings, MSDS and warning labels reliability of were very low levels. The composition chemical substance used for production of powder coatings to synthetic resin, hardening agent, pigment, an additive. The Lead chromate was contained in 0.1-25% by suspected human carcinogen substance by 9 powder coatings, and silica was contained in 5-20% by cause substance of silicosis by 3 powder coatings. The inhalable particulate mass(0-10 μ m) was approximately 2.75% in particle size of powder coatings, and the thoracic particulate mass(0-25 μ m) was approximately 22.3%.

If chemical substance composition component was omission of record and only a part list was 34.1% in MSDS, and it was a state to be low with 59% if a harmfulness classification was omission of record and a part list for it. A composition component and a content did not become a

record in warning labels of all powder coatings, and a hazard pictographs of warning labels was approximately 56.8% if not adhesion. If toxicity information about powder coatings was omission of record, it was 97.7%, and the case that omission of record an TLV-TWA about component chemical substance was 75% level. There are an increasing number of problems associated with the regular monitoring of workplace environment, based on MSDS; more and more health-related problems are related to the management of harmful chemical substances. Under these circumstances, regarding these harmful substances, there is a compelling need for systematically examining the accuracy of MSDSs, and deeply investigating and evaluating toxic chemicals.

Key Words: Lead chromate, MSDS, NTP, NIOSH-RTECS, Particle size, Powder coatings, Reliability, TEM-EDS, UNEP-SIDS.

: 2004 7 6 , : 2004 10 12

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I. 서 론

(agreement rate)

MSDS

MSDS

MSDS

가

coatings)

(powder

(ILO, 1990),

(International Organization for Standardization, ISO) ISO 11014-1:1994E 「

,

가 10%

가

100%

SDS(Safety Data Sheets)

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,

가 10%

16

MSDS

가

(ISO, 1994).

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1997).

MSDS

(right to know)

1996 7 1

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가

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(Paul *et*

(

al., 1995; Charles *et al.*, 1999;

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, 1996;

, 1997).

2002).

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MSDS

(2000)

MSDS

MSDS

(qualitative

가

(1998)

analysis)

National Toxicology Program(NTP)

Chemical Health and Safety Data,

Organization for Economic Cooperation and

Development (OECD) United Nations

Environment Programme(UNEP)

(High

Production Volume Chemicals, HPV)

(Material Safety Data
Sheets, MSDS)

ICP-AES

MSDS

(2003)

MSDS

MSDS

(International Labour Organi-
zation, ILO) 170 177
「

(provision rate)

Table 1. Sampling with 44 kinds of powder coatings and MSDS (unit : No. of Samples)

Use plants of powder coatings	Manufacturer of powder coatings								
	Total	A	B	C	D	E	F	G	H
YA	6	3	2	1	-	-	-	-	-
JJ	5	-	-	-	5	-	-	-	-
SJ	3	-	-	-	-	3	-	-	-
AS	3	-	-	-	-	-	1	-	2
SH	8	8	-	-	-	-	-	-	-
KK	6	-	-	2	1	-	3	-	-
ET	6	-	-	1	-	-	-	5	-
CS	1	-	-	1	-	-	-	-	-
AT	1	-	-	-	-	-	1	-	-
SS	5	2	-	2	-	-	-	1	-
Total	44	13	2	7	6	3	5	6	2

Screening Information Dataset(SIDS), National Institute for Occupational Safety and Health(NIOSH) Registry of Toxic Effect of Chemical Substance(RTECS) database
MSDS
Table 2
3. 분체도료의 입자크기와 분포의 측정
가
Particle size analyzer(Microtrac S-3000, USA)
ISO 13320-1(Particle size analysis-Laser diffraction)

2. 분체도료내 금속성분의 분석
MSDS

cellulose ester membrane filter(pore size 0.22μm, diameter 25mm, Milipore, USA)
sensor (laser diffraction) 0.02μm ~ 2,000μm
(3mm²)
copper grid acetone vapor
filter
II. 시료 및 MSDS 분석방법

1. MSDS
2003 3 2003 7
10
Table 1
Dispersive X-ray Spectrometer (Horiba EX-200, Japan)가 Transmission Electron Micro- scope(Hitachi-7100FA)
sample grid Energy
MSDS 16
1 , 2
, 3
, 4
, 8
, 11
, 15
3
0.1% , 1.0%
(
Table

Parameters	Conditions
X-ray tube power	100 kV, 1 mA
Anode	Rh
Detector	Si(Li)
Spectrum analysis	MCA(2048 channel)
Resolution	155 eV at Mn K
Measurement	100 sec
Analysis	K Line

Checking items	Checking contents
Section 1. Chemical product and company identification	substance name, trade name, chemical family, creation data, revision data, information of manufacturer
Section 2. Composition/information on ingredients	chemical name, component, percentage, CAS number
Section 3. Health and Hazards identification	NFPA ratings, potential health effects(inhalation, skin, eye, ingestion), carcinogen status(NTP, NIOSH, IARC) emergency overview
Section 4. First aid measures	inhalation, skin, eye, ingestion
Section 5. Fire fighting measures	flash point, autoignition temp., lower/upper flammable limit, arrangement contents in the fire services act
Section 8. Exposure controls/personal protection	exposure limit, measurement method, ventilation, clothing, glove, respirator, eye protection
Section 9. Physical and chemical properties	color, odor, boiling point, freezing point, solubility, pH, specific gravity, molecular formula, molecular weight
Section 10. Stability and reactivity	reactivity, stability, incompatibilities, conditions to avoid, hazardous decomposition, polymerization
Section 11. Toxicological information	acute toxicity data(oral, skin, inhalation), carcinogenic data, mutation data, reproductive data, skin/eye irritation data, chronic toxicity data
Section 12. Ecological information	environmental impact rating, acute aquatic toxicity, bioaccumulation, persistence/ degradability, environmental impact
Section 13. Disposal considerations	disposal way
Section 14. Transport information	warning matter
Section 15. Regulation information	industrial safety and health act, Harmfulness chemical control act, product liability act, fire services act
Section 16. Other information (product container warning labels)	health and safety information as written on the label. component and percentage record contents

)

(, CAS 1. 분체도료의 제조방법 및 제조현황 .

) “ ” ,

2 가 , , 가

database . 가가 ,

Figure 1 .

가 , , , 가 가

MSDS (hopper) .

가 100~120

가 , .

Table 4

가 NTP- chemical health and (sheet) (chip) .

safety data, UNEP-SIDS, NIOSH- RTECS (5~15mm) 7

database 가

(NIOSH, 2003; UNEP, 2003; NTP, . 2002

2003). 28,539^M/T ,

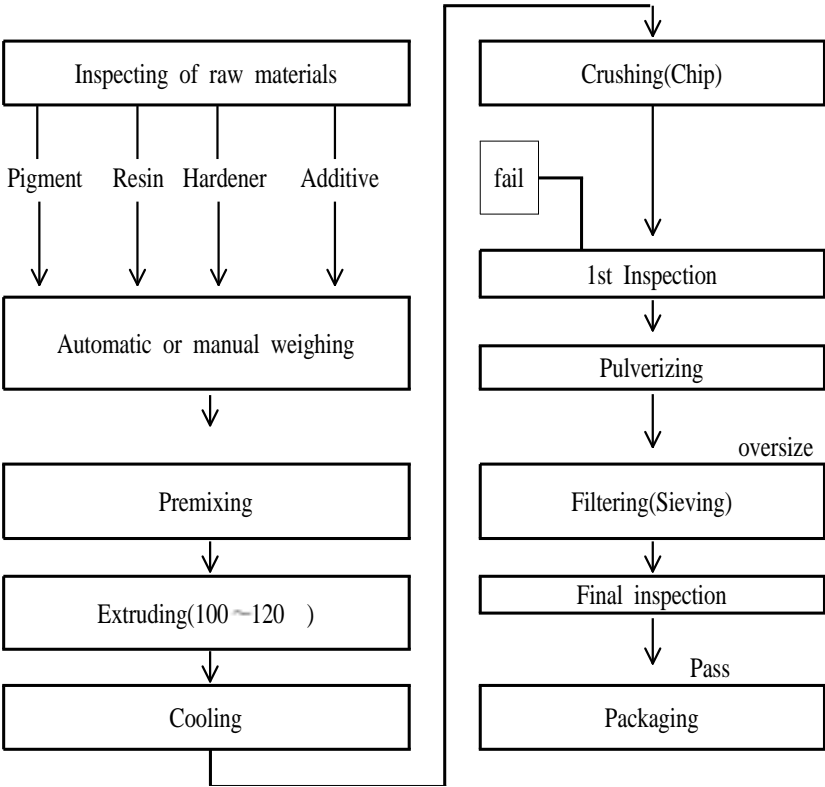


Fig 1. Manufacuring process for powder coatings.

, 2003), 가
(American Conference of Govern- mental
Industrial Hygienists, ACGIH)
(A4) (titanium dioxide)
78.6% 22 5~
45% .
(lead
chromate) ACGIH
(A2)
((
(yellow)
, 2002; ACGIH, 2003),
(light green)
, 25% 9 0.
1~25% .
(silicosis) , ACGIH
(silica-quartz)
10.7% 3 5~20%

ACGIH

가

Table 5

2. 분체도료의 구성성분과 금속성분의
함유량 분석결과

1) 분체도료의 구성성분

MSDS

14

15~70%

11

(A4) Carbon black
Iron oxide 5 (17.9%), 3 (10.7%)
0.1~5% .
ACGIH
(Nat-
ional Institute for Occupational Safety and
Health, NIOSH) RTECS
(LD₅₀ 188 mg/kg-rat)
1,3,5-Triglycidyl iso-

Table 4. Amounts of powder coatings produced in Korea by year

(Metric tons, M/T)

Manufacturer of powder coatings	Amounts of powder coatings by year					
	1997	1998	1999	2000	2001	2002
KC	7,466	4,155	5,876	7,481	7,603	8,949
ANI	5,900	3,730	4,700	5,600	5,100	4,990
LF	3,000	1,750	3,200	3,370	3,100	3,300
CK	2,300	1,450	2,650	2,950	2,900	3,270
CS	2,800	1,150	1,750	2,480	2,300	2,820
HD	2,100	660	1,300	1,560	1,700	1,850
PW	0	920	1,800	2,500	3,100	3,360
Total	22,566	13,815	21,276	25,941	25,803	28,539

cyanurate 27.8% 9 2 (lead), (chromium) 9 ,
0.1~8% 18 ACGIH
(NIOSH, 2003). Titanium 가 39 (TLVs-TWA)
(88.6%) 4.0~91.4% 12 .
2) 금속성분의 함유량 분석결과 , Barium, Silica, Aluminum,
44 Calcium, Sulfur
2
Table 6 11 ACGIH 0~100μm

3. 분체도료의 입자크기별 분포도 분석결과

Table 5. Type and frequency of chemical substance in powder coatings

Substance name	CAS No.	Information on ingredients			TLV-TWA, mg/m ³		Carcino- genicity
		Detection No.	Frequency (%)	Ratio (%)	Ministry of Labor	ACGIH	
Barium sulfate	7727-43-7	14	50.0	1~30	10	10	-
Benzenepropanoic acid	6683-19-8	9	32.1	0.2~4.0	-	-	-
Benzoin	119-53-9	3	10.7	0.2~0.5	-	-	-
Calcium carbonate	471-34-1	15	53.6	1~40	-	10	-
Carbon black	1333-86-4	5	17.9	0.1~5	3.5	3.5	A4
Copper phalocyanine	147-14-8	1	3.6	0.5	-	-	-
Iron oxide	1309-37-1	3	10.7	0.1~5	5	5	A4
Lead chromate	7758-97-6	9	25.0	0.1~25	0.05	0.05(Pb) 0.012(Cr)	A2
Polyester & Epoxy resin(all isomers)	25135-73-3 25036-25-3 25068-38-6	28	100	15~70	-	-	-
Silica	14808-60-7	3	10.7	5~20	0.1	0.05	A2
Titanium dioxide	13463-67-7	22	78.6	5~45	10	10	A4
1,3,5-Triglycidyl isocyanurate	2451-62-9	10	27.8	0.1~8	-	0.05	-

Table 6. Analysis of metal composition in powder coatings

Metal name	CAS No.	Information on ingredients			TLV-TWA, mg/m ³		Carcino- genicity
		Detection No.	Frequency (%)	Ratio (%)	Ministry of Labor	ACGIH	
Alumium(Al)	7429-90-5	27	61.4	0.1~14.5	10	10	-
Antimony(Sb)	7440-36-0	11	25.0	0.3~24.4	0.5	0.5	-
Barium(Ba)	7440-39-3	32	72.7	1.4~94.7	0.5	0.5	A4
Calcium(Ca)	7440-70-2	27	61.4	0.1~60.4	-	-	-
Cerium(Ce)	7740-45-1	15	34.1	0.1~4.5	-	-	-
Cesium(Cs)	7740-46-2	4	9.0	0.7~45.4	-	-	-
Chromium(Cr)	7440-47-3	10	22.7	1.2~18.8	0.5	0.5	A4
Hafnium(Hf)	7440-58-6	11	25.0	0.1~12.4	0.5	0.5	-
Iron oxide(Fe ₂ O ₃)	1309-37-1	11	25.0	0.1~5.4	5	5	A4
Lead(Pb)	7439-92-1	4	9.0	0.1~34.0	0.05	0.05	A3
Magnesium oxide(MgO)	1309-48-4	7	15.9	0.4~12.7	10	10	A4
Molybdenum(Mo)	7439-98-7	4	9.0	0.2~2.7	10	10	-
Silica(Si)	7440-21-3	30	68.2	0.1~34.0	-	-	-
Sulfur(S)	7704-34-9	26	59.1	0.2~30.9	-	-	-
Tin(Sn)	7440-31-5	2	4.55	0.4~1.2	2	2	-
Titanium dioxide	13463-67-7	39	88.6	4.0~91.4	10	10	A4
Vanadium(V)	7440-62-2	2	4.55	0.9~6.2	-	-	-
Zinc oxide(ZnO)	1313-13-2	2	4.55	0.1~2.9	10	2	-

Table 7. Analysis of particle size distribution on exposure powder coatings

Particle size (μm)	No. of samples	Particle size distribution(%)		
		Mean	Range	Cumulative ratio
101	3	1.21	0.11 - 3.26	100.00
81 ~ 100	3	1.79	0.92 - 3.15	98.79
61 ~ 80	3	15.31	12.92 - 17.09	97.00
41 ~ 60	3	34.17	29.15 - 41.72	81.69
26 ~ 40	3	23.42	19.15 - 26.99	47.52
11 ~ 25	3	21.35	19.51 - 23.51	24.10
6 ~ 10	3	2.50	1.04 - 3.25	2.75
5	3	0.25	0 - 0.58	0.25

(inhalable particulate mass, IPM) 0~25 μm 1(16가
(thoracic particulate mass, TPM) 0~10 μm 가
(respirable particulate mass, RPM) 44
-000 13 (29.5%)

Table 7 가
Figure 2 가
0~10 μm EB038KD PAPER WHITE, (lead chromate),
2.75%, 0~ LH-ME/SL032G, E3000K SILVER 1,3,5-Triglycidyl Isocyanurate
25 μm 24.1% METAL
가 57.59% MSDS (silica-quartz)
가

4. 분체도료 MSDS 작성내용 분석결과
MSDS MSDS 17 (38.6%) MSDS
Table 8 1 25 (56.8%)
17 (38.6%), 8 (18.2%)
가

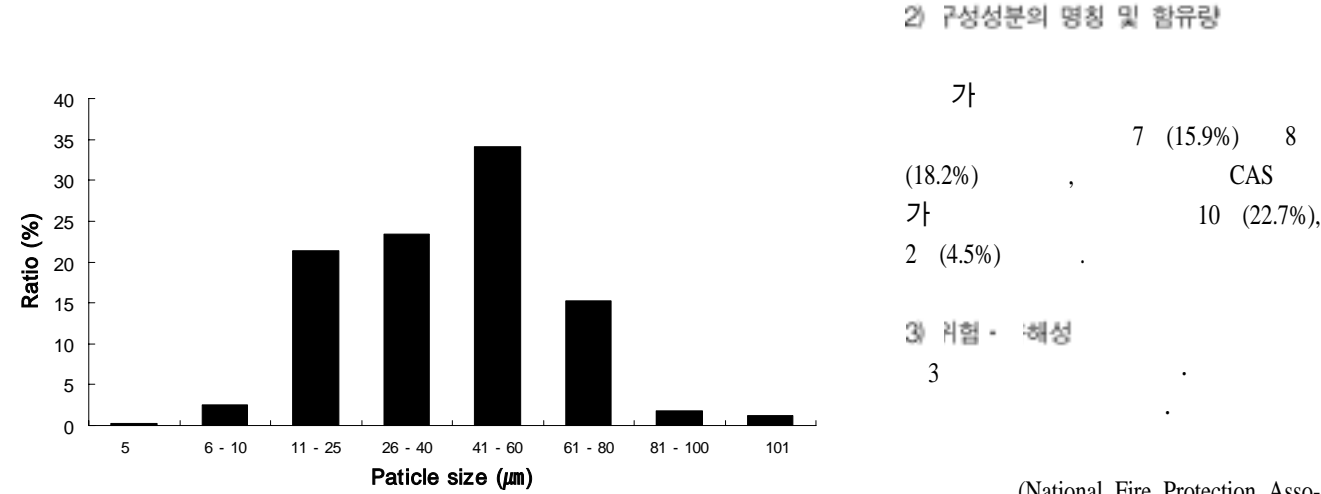


Fig 2. Particle size histogram of powder coatings.

(National Fire Protection Association, NFPA) (NFPA

Table 8. Result of checking subjects in MSDS for powder coatings

Checking items		Total (44)		Production company							
		No. of case	rate (%)	A (13)	B (2)	C (7)	D (6)	E (3)	F (5)	G (6)	H (2)
Chemical product and company identification	Unsuitable record of product name	44	100	13	2	7	6	3	5	6	2
	Unsuitable record of chemical family	13	29.5	-	2	5	2	-	-	4	-
	Omission of general characteristic	17	38.6	13	2	-	-	-	-	-	2
	Unsuitable record of chemical family	13	29.5	8	-	2	2	-	1	-	-
	Omission of company identification	17	38.6	-	-	5	6	-	-	6	-
	Unsuitable record of creation data	8	18.2	-	2	1	5	-	-	-	-
	Unsuitable record of revision data	25	56.8	13	2	1	6	-	1	-	2
Composition/information on ingredients	Omission of chemical composition	7	15.9	5	-	-	-	-	-	-	2
	Part list of chemical composition	8	18.2	8	-	-	-	-	-	-	-
	Wrong list of chemical substance name	10	22.7	-	-	-	6	1	2	1	-
	Unsuitable record of CAS number	2	4.5	-	2	-	-	-	-	-	-
Health and hazards	Unsuitable record of NFPA ratings	37	84.1	13	2	7	6	-	1	6	2
	Unsuitable record of effect on human body	23	52.2	13	-	5	3	-	-	-	2
First aid measures	Unsuitable record of first aid measures	15	34.1	-	2	-	6	-	1	6	-
Exposure controls/ personal protection	Omission of TLV	33	75.0	5	2	4	6	3	5	6	2
	Part list of TLV	10	22.7	8	-	2	-	-	-	-	-
	Unsuitable record of TLV	9	20.5	8	-	1	-	-	-	-	-
	Omission of engineering method	15	34.1	13	-	-	-	-	-	-	2
	Unsuitable record of engineering method	6	13.6	-	-	-	6	-	-	-	-
	Unsuitable record of personal protection	-	-	-	-	-	-	-	-	-	-
Toxicological information	Omission of record	43	97.7	13	2	7	6	3	4	6	2
	Part list of toxicological information	1	2.3	-	-	-	-	-	1	-	-
Regulation information unsuitable record	Industrial safety and health act	33	75.0	13	2	2	4	-	4	6	2
	Fire services act	-	-	-	-	-	-	-	-	-	-
	Harmfulness chemical control act	-	-	-	-	-	-	-	-	-	-
	Product liability act	44	100	13	2	7	6	3	5	6	2
Product container warning labels	Omission of chemical composition	44	100	13	2	7	6	3	5	6	2
	Part list of chemical composition	-	-	-	-	-	-	-	-	-	-
	Omission of adhesion warning labels	25	56.8	5	2	5	5	-	1	6	1

rating)가

5) 배출기준 및 공학적 대책

6 (13.6%)

84.1% 37

ACGIH

가

33

23 (52.2%)

(75.0%)

6) 특성에 관한 정보

가 10

43

4) 응급조치 요령

(22.7%)

(97.7%) MSDS가

9 (20.5%)

1 MSDS

Table 9

MSDS
15 (34.1%)15 (34.1%)
가

Toxicology

Program(NTP)

National
Chemical

Health and Safety Data , 1989 Barium sulfate, Iron oxide 2
 (Organization (NFAA) (NFAA)
 for Economic Cooperation and Devel- (NFAA rating)가 7) 제품용기에 부착된 경고표지의 화학물
 opment, OECD) Titanium dioxide, 1,3,5-Triglycidyl 질정보 표기내용
 (United Nations Environment Progra- isocyanurate 7 (58.3%) , .
 mme, UNEP) 가 가
 (High Production KOSHA.NET MSDS
 Volume Chemicals, HPV) Scree- MSDS
 ning Information Dataset(SIDS)가
 Copper phalocyanine 1 ,
 National Institute for Occupational Safety
 and Health(NIOSH) Registry of Toxic 33 (75.0%) , 2002 7 1
 Effect of Chemical Substance(RTECS) (PL)
 가 25 (56.8%) .

Table 9. Summary of acute toxicity data for powder coatings component

Substance name	Acute toxicity data	TLV basis critical effects	NFPA Rating (H/F/R)	Offer of MSDS, KOSHA	Reference No.
Barium sulfate 7727-43-7	-	Pneumoconiosis (baritosis)	1/0/0		RTECS CR0600000
Benzenepropanoic acid 6683-19-8	Oral LD50 5000mg/kg-rat Skin LD50 >3160mg/kg-rabbit	-	-		RTECS DA8340900
Benzoin 119-53-9	Oral LD50 >3gm/kg-mouse LD50 10gm/kg-rat Skin LD50 8870mg/kg-rabbit	-	-		RTECS DI1590000
Calcium carbonate 471-34-1	Oral LD50 6450mg/kg-rat	Irritation	2/0/0		RTECS FF9335000
Carbon black 1333-86-4	Oral LD50 10gm/kg-rat Skin LD50 3gm/kg-rabbit	A4, Lung	1/1/0		RTECS FF5800000
Copper phalocyanine 147-14-8	Oral LD50 10000mg/kg-rat Oral LD50 16000mg/kg-rabbit	-	-		UNEP SIDS
Iron oxide 1309-37-1	-	A4, Pneumoconiosis	0/0/0		RTECS NO7400000
Lead chromate 7758-97-6	Oral LD50 12gm/kg-rat	A2, Cancer, reproductive	4/0/1		RTECS GB2975000
Polyester & Epoxy resin(all isomers) 25068-38-6	Oral LD50 11400mg/kg-rat Oral LD50 20gm/kg-mouse	-	-		RTECS KC2625000
Silica 14808-60-7	Inhl LCLo 300µg/m ³ /10y Intermittent-human	A2, cancer Silicosis	-		RTECS VV7330000
Titanium dioxide 13463-67-7	Oral LD50 >24000mg/kg-rat Inhl LC50 6820mg/m/4hr-rat	A4, Lung	-		RTECS XR2275000
1,3,5-Triglycidyl isocyanurate 2451-62-9	Oral LD50 188mg/kg-rat	Blood reproductive	-		RTECS XZ1994900

IV. 고 찰

MSDS 97.7% ,

(Material Safety Data Sheet, MSDS) 가 ,

MSDS MSDS (2003)

MSDS MSDS

MSDS

(Kolp *et al.*, 1993; Clayton *et al.*, 1994; OSHA, 2002). 1996 7 1 MSDS MSDS

MSDS 46.5%, 28.3%

(, 1997), , MSDS MSDS

MSDS 가 MSDS

MSDS ,

MSDS 1 , 2 MSDS 가

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(, 11 가 MSDS

MSDS , 15 ,

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MSDS MSDS

MSDS (2 1)

MSDS update MSDS

(Kolp *et al.*, 1993; Paul *et al.*, 1995; Charles *et al.*, 1999; , 2002). MSDS MSDS

MSDS 가 34.1% , (, 2003)

가 59% MSDS (, 1997)

MSDS 가

MSDS MSDS

MSDS

(50,428 MSDS database) MSDS

(1998) 가 MSDS

/ ICP-AES MSDS

MSDS MSDS

MSDS update가 56.8% 가

MSDS MSDS database 가

MSDS assurance system) MSDS (quality

(,) 가 56.8% .
 4. 가
 MSDS (2 1 가
 MSDS) 가 97.7% ,
 MSDS 75% .
 16 5. MSDS
 가
 MSDS , MSDS
 MSDS , 1
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V. 결 론

feedback 10 ,
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44 .
 MSDS 가
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MSDS

MSDS

1.

15~70% , , , 가 /

ICP-AES

MSDS

, MSDS 2

(lead chromate) 25% 9

0.1~25%

(silicosis)

(

(silica-quartz) 3 5~20%

113 , 23 ,
 17 , 가 15)

2.

0~10 μ m 가 2.75%,

100%가

0~25 μ m 가

24.1%

26~60 μ m

가 57.59%

3. MSDS

MSDS , CAS

가 34.1%

가

59%

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