

มหาวิทยาลัยเชียงใหม่
Chiang Mai University

ภาคผนวก

ภาคผนวก ก

รายละเอียดข้อกำหนดทางวัตถุดิบสำหรับอุตสาหกรรมแก้ว หน่วยงาน ACI ; Glass Packing Division สำหรับวัตถุดิบประเภท

- หินปูน (Limestone)
- ซอลท์ เค้ก (Salt Cake)
- ทราช (Silica Sand)
- โซดาแอส (Soda Ash)
- หินฟันม้า (Feldspar)
- โดโลไมต์ (Dolomite)
- แมกนีไซต์ (Magnesite)



PURCHASE ACCEPTANCE STANDARD

P.A.S. 014-01 LIMESTONE (COLOURLESS GLASS)

- A. SCOPE
This specification prescribes the requirements both physical and chemical for "Limestone" suitable for the manufacture of "Colourless Container Glasses" by ACI Glass Packaging.
- B. GENERAL DESCRIPTION
Grey to white powder, may be slightly granular.

C. CHEMICAL DESCRIPTION
Calcium Carbonate (limestone, marble) $CaCO_3$

- D. SPECIFICATION
(a) Chemical Composition

CaO + MgO	55% Min.
MgO	1% Max.
SiO ₂	1% Max.
Fe ₂ O ₃	0.12% Max.
H ₂ O	Note I

Note I
The maximum acceptable figure for the percentage moisture content of the limestone as received shall not exceed 1 (one) per cent.

- (b) Physical Properties

Nominal Size of Aperture mm	BSS English	USBS American	TYLER American	ACI Standard Specification
1.000	+16	+18	+16	NIL
0.075	-200	-200	-200	5% Max.

NOTE: British Standard Sieves are used.

The chemical and physical composition of the material must remain uniform from shipment to shipment.

This material must be free of foreign matter detrimental to the glass melting process such as colouring materials or refractory particles.

RAW MATERIAL PACKED IN BAGS

All bags must be properly identified.

E. TEST METHODS AND SAMPLING

Methods employed by ACI as developed by ACI Engineering Services.

F. REJECTIONS

ACI reserves the right to reject any portion or all of the material furnished under this specification which does not conform to all of the requirements set forth herein upon receipt at ACI designated stores.

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PURCHASE ACCEPTANCE STANDARD

P.A.S. 015-01 LIMESTONE (COLOURED GLASS)

A. SCOPE

This specification prescribes the requirements both physical and chemical for "Limestone" suitable for the manufacture of "Coloured Container Glasses" by ACI Glass Packaging.

B. GENERAL DESCRIPTION

Grey to white powder, may be slightly granular.

C. CHEMICAL DESCRIPTION

Calcium Carbonate (limestone, marble) $CaCO_3$

D. SPECIFICATION

(a) Chemical Composition

CaO + MgO	55% Min.
MgO	1% Max.
SiO ₂	1% Max.
Fe ₂ O ₃	Maximum level and variation subject to agreement
H ₂ O	Note I

Note I

The maximum acceptable figure for the percentage moisture content of the limestone as received shall not exceed 1 (one) per cent.

(b) Physical Properties

Nominal Size of Aperture mm	BSS English	USBS American	TYLER American	ACI Standard Specification
0.100	+16	+18	+16	NIL
0.075	-200	-200	-200	5% Max.

NOTE: British Standard Sieves are used.

The chemical and physical composition of the material must remain uniform from shipment to shipment.

This material must be free of foreign matter detrimental to the glass melting process such as colouring materials or refractory particles.

RAW MATERIAL PACKED IN BAGS

All bags must be properly identified.

E. TEST METHODS AND SAMPLING

Methods employed by ACI as developed by ACI Engineering Services.

F. REJECTIONS

ACI reserves the right to reject any portion or all of the material furnished under this specification which does not conform to all of the requirements set forth herein upon receipt at ACI designated stores.

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PURCHASE ACCEPTANCE STANDARD

P.A.S. 017-01 SALTCAKE

A. SCOPE
This specification prescribes the requirements both physical and chemical for "Saltcake" suitable for the manufacture of "Container Glasses" by ACI Glass Packaging.

B. GENERAL DESCRIPTION
Crystalline free-flowing powder.

C. CHEMICAL DESCRIPTION
Sodium Sulphate Na₂SO₄

D. SPECIFICATION
(a) Chemical Composition

Na ₂ SO ₄	98% Min.
Fe ₂ O ₃	0.05% Max.

(b) Physical Properties

Nominal Size of Aperture mm	BSS English	USBS American	TYLER American	ACI Standard Specification
1.000	+16	+18	+16	NIL
0.075	-200	-200	-200	10% Max.

NOTE: British Standard Sieves are used.

The chemical and physical composition of the material must remain uniform from shipment to shipment.

This material must be free of foreign matter detrimental to the glass melting process such as colouring materials or refractory particles.

RAW MATERIAL PACKED IN BAGS

All bags must be properly identified.

E. TEST METHODS AND SAMPLING
Methods employed by ACI as developed by ACI Engineering Services.

F. REJECTIONS
ACI reserves the right to reject any portion or all of the material furnished under this specification which does not conform to all of the requirements set forth herein upon receipt at ACI designated stores.

**PURCHASE ACCEPTANCE STANDARD**P.A.S. 018-01 SAND FOR COLOURED
CONTAINER GLASS PRODUCTION

- A. SCOPE
This specification prescribes the requirements both physical and chemical for "Sand" suitable for the manufacture of "Coloured Container Glasses" by ACI Glass Packaging.
- B. GENERAL DESCRIPTION
Minute fragments resulting from the wearing down of siliceous rocks. This material consists of silica plus other impurities of which iron and chromium oxides are the most objectionable ones.
- C. CHEMICAL DESCRIPTION
Silica (quartz) SiO_2
- D. SPECIFICATION
(a) Chemical Composition
- | | |
|-------------------------|--|
| SiO_2 | 98% Min. |
| Fe_2O_3 | 0.2% Max. -(must be consistent - Note I) |
| Cr_2O_3 | 0.001% Max. |
| Al_2O_3 | Note II |
| H_2O | Note III |

Note I

The maximum permissible iron oxide content of the sand can be calculated by means of an iron balance of the respective glass batch. Under certain circumstances it may be possible to use a sand with an iron level above 0.2% Fe_2O_3 .

Note II

The maximum acceptable alumina level is negotiable. The level however must remain within $\pm 0.05\%$ of the nominated value.

Note III

The maximum acceptable figure for the percentage moisture content of the sand as received shall not exceed 6 (six) per cent.

(b) Physical Properties

Nominal Size of Aperture mm	BSS English	USBS American	TYLER American	ACI Standard Specification
1.000	+16	+18	+16	NIL
0.600	+25	+30	+28	2% Max.
0.425	+36	+40	+35	10% Max.
0.106	-150	-140	-150	1% Max.

NOTE: British Standard Sieves are used.

(c) Chrome Stones

Mean Optical Diameter	Preferred Limit No./tonne	Working Limit No./tonne
Total + 0.3mm	500	1000
Total + 0.4mm	200	400
Total + 0.4mm	100	200
Total + 0.6mm	NIL	NIL

Stone levels are based on a test using 30kg of sand and a one hour melt as developed by ACI GPD Engineering Services.

The chemical and physical composition of the material must remain uniform from shipment to shipment.

This material must be free of foreign matter detrimental to the glass melting process such as undersirable colouring materials or refractory particles. In particular the material must be free of picotite or iron chromite particles.

E. TEST METHODS AND SAMPLING

Methods employed by ACI as developed by ACI Engineering Services.

F. REJECTIONS

ACI reserves the right to reject any portion or all of the material furnished under this specification which does not conform to all of the requirements set forth herein upon receipt at ACI designated stores.

**PURCHASE ACCEPTANCE STANDARD****P.A.S. 019-01 SAND FOR COLOURLESS
CONTAINER GLASS PRODUCTION****A. SCOPE**

This specification prescribes the requirements both physical and chemical for "Sand" suitable for the manufacture of "Colourless Container Glasses" by ACI Glass Packaging. For the purpose of this specification, a colourless glass is defined as one which when viewed through the thickness normally encountered in practice has no appreciable tint and contains not more than 0.06% Fe₂O₃.

B. GENERAL DESCRIPTION

Minute fragments resulting from the wearing down of siliceous rocks. This material consists of silica plus other impurities of which iron and chromite oxide are the most objectionable.

C. CHEMICAL DESCRIPTION

Silica (quartz) SiO₂

D. SPECIFICATION**(a) Chemical Composition**

SiO ₂	99% Min.
Fe ₂ O ₃	0.03% Max.
TiO ₂	0.1% Max.
Cr ₂ O ₃	0.0006% Max.
Al ₂ O ₃	Note I
H ₂ O	Note II

Note I

The maximum acceptable alumina level is negotiable. The level however must remain within $\pm 0.05\%$ of the nominated value.

Note II

The maximum acceptable figure for the percentage moisture content of the sand as received shall not exceed 6 (six) per cent).

(b) Physical Properties

Nominal Size of Aperture mm	BSS English	USBS American	TYLER American	ACI Standard Specification
1.000	+16	+18	+16	NIL
0.600	+25	+30	+28	2% Max.
0.415	+36	+40	+35	10% Max.
0.105	-150	-140	-150	1% Max.

NOTE: British Standard Sieves are used.

(c) Chrome Stones

Mean Optical Diameter	Preferred Limit No./tonne	Working Limit No./tonne
Total + 0.3mm	500	1000
Total + 0.4mm	200	400
Total + 0.4mm	100	200
Total + 0.6mm	NIL	NIL

Stone levels are based on a test using 30kg of sand and a one hour melt as developed by ACI GPD Engineering Services.

The chemical and physical composition of the material must remain uniform from shipment to shipment.

This material must be free of foreign matter detrimental to the glass melting process such as undersirable colouring materials or refractory particles. In particular the material must be free of picotite or iron chromite particles.

E. TEST METHODS AND SAMPLING

Methods employed by ACI as developed by ACI Engineering Services.

F. REJECTIONS

ACI reserves the right to reject any portion or all of the material furnished under this specification which does not conform to all of the requirements set forth herein upon receipt at ACI designated stores.

PURCHASE ACCEPTANCE STANDARD

P.A.S. 024-01 SODA ASH

- A. SCOPE
This specification prescribes the requirements both physical and chemical for "Soda Ash" suitable for the manufacture of "Container Glasses" by ACI Glass Packaging.
- B. GENERAL DESCRIPTION
White, granular, free-flowing powder.
- C. CHEMICAL DESCRIPTION
Sodium Carbonate Anhydrous Na_2CO_3
- D. SPECIFICATION
- (a) Chemical Composition
- | | |
|--------------------------|---|
| Na_2CO_3 | 99% Min. (97% Min. for Magadi Soda Ash) |
| Fe_2O_3 | 0.01% Max. |
- (b) Physical Properties
- | Nominal
Size of
Aperture
mm | BSS
English | USBS
American | TYLER
American | ACI
Standard
Specification |
|--------------------------------------|----------------|------------------|-------------------|----------------------------------|
| 1.000 | +16 | +18 | +16 | NIL |
| 0.106 | -150 | -140 | -150 | 8% Max. |
| 0.075 | -200 | -200 | -200 | 2% Max. |
- NOTE:** British Standard Sieves are used.
- The chemical and physical composition of the material must remain uniform from shipment to shipment.
- This material must be free of foreign matter detrimental to the glass melting process such as colouring materials or refractory particles.
- E. RAW MATERIAL PACKED IN BAGS
All bags must be properly identified.
- F. TEST METHODS AND SAMPLING
Methods employed by ACI as developed by ACI Engineering Services.
- G. REJECTIONS
ACI reserves the right to reject any portion or all of the material furnished under this specification which does not conform to all of the requirements set forth herein upon receipt at ACI designated stores.

**PURCHASE ACCEPTANCE STANDARD**P.A.S. 027-01 FELDSPAR (SODA)

- A. SCOPE
This specification prescribes the requirements both physical and chemical for "Soda Feldspar" suitable for the manufacture of "Container Glasses" by ACI Glass Packaging.
- B. GENERAL DESCRIPTION
White crystalline mineral.
- C. CHEMICAL DESCRIPTION
Sodium Aluminium Silicate (Soda Feldspar) $\text{NaAlSi}_3\text{O}_8$
- D. SPECIFICATION
(a) Chemical Composition

Al_2O_3	Subject to agreement between supplier and ACI.
Fe_2O_3	0.2% Max. (Note I)
CaO	This should not vary by more than $\pm 0.5\%$ from the agreed value.
$\text{Na}_2\text{O} + \text{K}_2\text{O}$	8% Min. as Na_2O equivalent
H_2O	Note II

Note I

This specification calls for 0.2% Fe_2O_3 maximum, however, a higher iron level may be acceptable depending on the purities of other materials used by the respective plant, colour requirements, glass type and target total iron level in the glass. Colouring materials, other than Fe_2O_3 , are not to be present to an extent where they would produce appreciable colour in the glass.

Note II

The maximum acceptable figure for the percentage moisture content of the feldspar as received shall not exceed 1 (one) per cent.

(b) Physical Properties

Nominal Size of Aperture mm	BSS English	USBS American	TYLER American	ACI Standard Specification
1.00	+16	+18	+16	NIL
0.600	+25	+30	+28	10% Max.
0.075	-200	-200	-200	5% Max.

NOTE: British Standard Sieves are used.

The chemical and physical composition of the material must remain uniform from shipment to shipment.

This material must be free of foreign matter detrimental to the glass melting process such as colouring materials or refractory particles.

RAW MATERIAL PACKED IN BAGS

All bags must be properly identified.

E. TEST METHODS AND SAMPLING

Methods employed by ACI as developed by ACI Engineering Services.

F. REJECTIONS

ACI reserves the right to reject any portion or all of the material furnished under this specification which does not conform to all of the requirements set forth herein upon receipt at ACI designated stores.

**PURCHASE ACCEPTANCE STANDARD**P.A.S. 035-01 DOLOMITE (COLOURLESS GLASS)A. SCOPE

This specification prescribes the requirements both physical and chemical for "Dolomite" suitable for the manufacture of "Colourless Container Glasses" by ACI Glass Packaging.

B. GENERAL DESCRIPTION

Pink to white powder, may be slightly granular.

C. CHEMICAL DESCRIPTION

Calcium Magnesium Carbonate (dolomite, dolomitic limestone)
 $\text{CaCO}_3 \cdot \text{MgCO}_3$

D. SPECIFICATION(a) Chemical Composition

CaO + MgO	50% Min.
MgO	18% Min.
SiO ₂	1% Max.
Fe ₂ O ₃	0.12% Max.
H ₂ O	Note I

Note I

The maximum acceptable figure for the percentage moisture content of the dolomite as received shall not exceed 1 (one) per cent.

(b) Physical Properties

Nominal Size of Aperture mm	BSS English	USBS American	TYLER American	ACI Standard Specification
1.000	+16	+18	+16	NIL
0.075	-200	-200	-200	5% Max.

NOTE: British Standard Sieves are used.

The chemical and physical composition of the material must remain uniform from shipment to shipment.

This material must be free of foreign matter detrimental to the glass melting process such as colouring materials or refractory particles.

RAW MATERIAL PACKED IN BAGS

All bags must be properly identified.

E. TEST METHODS AND SAMPLING

Methods employed by ACI as developed by ACI Engineering Services.

F. REJECTIONS

ACI reserves the right to reject any portion or all of the material furnished under this specification which does not conform to all of the requirements set forth herein upon receipt at ACI designated stores.

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PURCHASE ACCEPTANCE STANDARD

P.A.S. 036-01 DOLOMITE (COLOURED GLASS)

A. SCOPE

This specification prescribes the requirements both physical and chemical for "Dolomite" suitable for the manufacture of "Colourless Container Glasses" by ACI Glass Packaging.

B. GENERAL DESCRIPTION

Pink to white powder, may be slightly granular.

C. CHEMICAL DESCRIPTION

Calcium Magnesium Carbonate (dolomite, dolomitic limestone)
CaCO₃.MgCO₃

D. SPECIFICATION

(a) Chemical Composition

CaO + MgO	50% Min.
MgO	18% Min.
SiO ₂	1% Max.
Fe ₂ O ₃	Maximum level and variation subject to agreement
H ₂ O	Note I

Note I

The maximum acceptable figure for the percentage moisture content of the dolomite as received shall not exceed 1 (one) per cent.

(b) Physical Properties

Nominal Size of Aperture mm	BSS English	USBS American	TYLER American	ACI Standard Specification
1.000	+16	+18	+16	NIL
0.075	-200	-200	-200	5% Max.

NOTE: British Standard Sieves are used.

The chemical and physical composition of the material must remain uniform from shipment to shipment.

This material must be free of foreign matter detrimental to the glass melting process such as colouring materials or refractory particles.

RAW MATERIAL PACKED IN BAGS

All bags must be properly identified.

E. TEST METHODS AND SAMPLING

Methods employed by ACI as developed by ACI Engineering Services.

F. REJECTIONS

ACI reserves the right to reject any portion or all of the material furnished under this specification which does not conform to all of the requirements set forth herein upon receipt at ACI designated stores.



PURCHASE ACCEPTANCE STANDARD

P.A.S. 037-01 MAGNESITE (COLOURLESS GLASS)

A. SCOPE

This specification prescribes the requirements both physical and chemical for "Magnesite" suitable for the manufacture of "Colourless Container Glasses" by ACI Glass Packaging.

B. GENERAL DESCRIPTION

Grey to white powder, may be slightly granular.

C. CHEMICAL DESCRIPTION

Magnesium Carbonate $MgCO_3$

D. SPECIFICATION

(a) Chemical Composition

MgO + CaO	43% Min.
CaO	1% Max.
Fe_2O_3	0.12% Max.
H_2O	Note I

Note I

The maximum acceptable figure for the percentage moisture content of the magnesite as received shall not exceed 1 (one) per cent.

(b) Physical Properties

Nominal Size of Aperture mm	BSS English	USBS American	TYLER American	ACI Standard Specification
1.000	+16	+18	+16	NIL
0.075	-200	-200	-200	5% Max.

NOTE: British Standard Sieves are used.

The chemical and physical composition of the material must remain uniform from shipment to shipment.

This material must be free of foreign matter detrimental to the glass melting process such as colouring materials or refractory particles.

RAW MATERIAL PACKED IN BAGS

All bags must be properly identified.

E. TEST METHODS AND SAMPLING

Methods employed by ACI as developed by ACI Engineering Services.

F. REJECTIONS

ACI reserves the right to reject any portion or all of the material furnished under this specification which does not conform to all of the requirements set forth herein upon receipt at ACI designated stores.

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**PURCHASE ACCEPTANCE STANDARD**P.A.S. 038-01 MAGNESITE (COLOURED GLASS)A. SCOPE

This specification prescribes the requirements both physical and chemical for "Magnesite" suitable for the manufacture of "Coloured Container Glasses" by ACI Glass Packaging.

B. GENERAL DESCRIPTION

Grey to white powder, may be slightly granular.

C. CHEMICAL DESCRIPTION

Magnesium Carbonate $MgCO_3$

D. SPECIFICATION(a) Chemical Composition

MgO + CaO	43% Min.
CaO	1% Max.
Fe_2O_3	Maximum level and variation subject to agreement.
H_2O	Note I

Note I

The maximum acceptable figure for the percentage moisture content of the magnesite as received shall not exceed 1 (one) per cent.

(b) Physical Properties

Nominal Size of Aperture mm	BSS English	USBS American	TYLER American	ACI Standard Specification
1.000	+16	+18	+16	NIL
0.075	-200	-200	-200	5% Max.

NOTE: British Standard Sieves are used.

The chemical and physical composition of the material must remain uniform from shipment to shipment.

This material must be free of foreign matter detrimental to the glass melting process such as colouring materials or refractory particles.

RAW MATERIAL PACKED IN BAGS

All bags must be properly identified.

E. TEST METHODS AND SAMPLING

Methods employed by ACI as developed by ACI Engineering Services.

F. REJECTIONS

ACI reserves the right to reject any portion or all of the material furnished under this specification which does not conform to all of the requirements set forth herein upon receipt at ACI designated stores.

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PURCHASE ACCEPTANCE STANDARD

P.A.S. 039-01 FELDSPAR (POTASH)

A. SCOPE
This specification prescribes the requirements both physical and chemical for "Potash Feldspar" suitable for the manufacture of "Container Glasses" by ACI Glass Packaging.

B. GENERAL DESCRIPTION
White crystalline mineral.

C. CHEMICAL DESCRIPTION
Potassium aluminium silicate (Potash Feldspar) $KAlSi_3O_8$

D. SPECIFICATION
(a) Chemical Composition

- Al_2O_3 Subject to agreement between supplier and ACI.
- Fe_2O_3 0.2% Max. (Refer Note I)
- CaO This should not vary by more than $\pm 0.5\%$ from the agreed value.
- Na_2O+K_2O 8% Min. as Na_2O equivalent.
- H_2O Note II

Note I

This specification calls for 0.2% Fe_2O_3 maximum, however, a higher iron level may be acceptable depending on the purities of other materials used by the respective plant, colour requirements, glass type and target total iron level in the glass. Colouring materials, other than Fe_2O_3 , are not to be present to an extent where they would produce appreciable colour in the glass.

Note II

The maximum acceptable figure for the percentage moisture content of the feldspar as received shall not exceed 1 (one) per cent.

(b) Physical Properties

Nominal Size of Aperture mm	BSS English	USBS American	TYLER American	ACI Standard Specification
1.000	+16	+18	+16	NIL
0.600	+25	+30	+28	10% Max.
0.075	-200	-200	-200	5% Max.

NOTE: British Standard Sieves are used.

The chemical and physical composition of the material must remain uniform from shipment to shipment.

This material must be free of foreign matter detrimental to the glass melting process such as colouring materials, metals or refractory particles.

RAW MATERIAL PACKED IN BAGS

All bags must be properly identified.

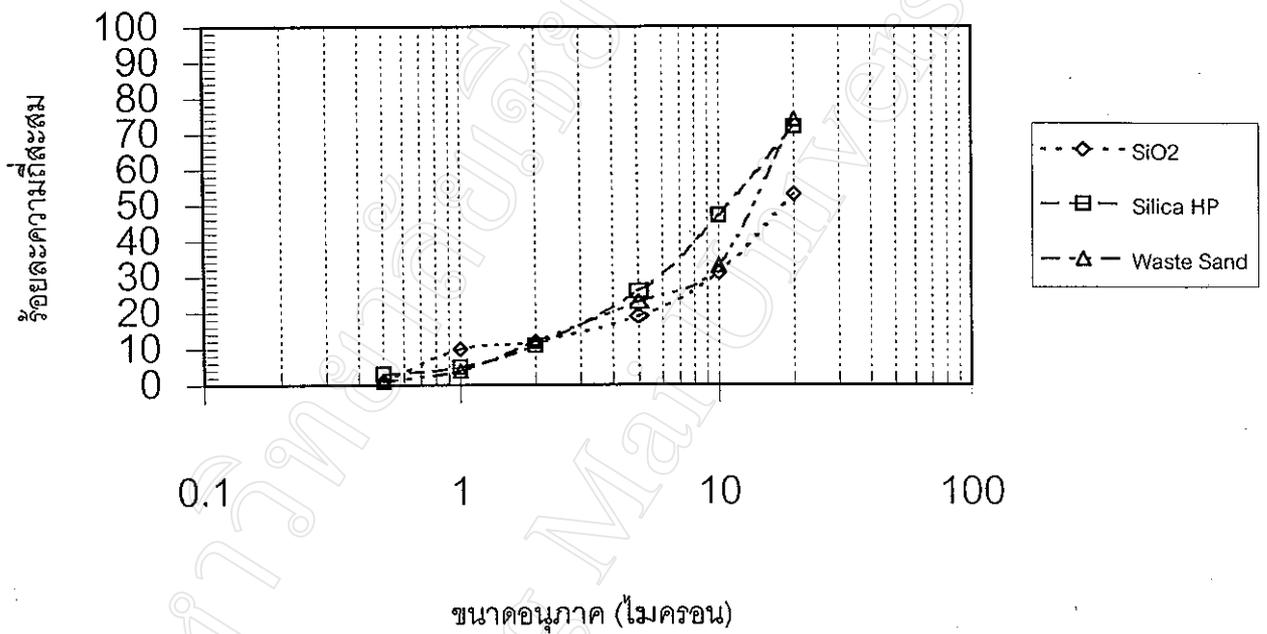
E. TEST METHODS AND SAMPLING

Methods employed by ACI as developed by ACI Engineering Services.

F. REJECTIONS

ACI reserves the right to reject any portion or all of the material furnished under this specification which does not conform to all of the requirements set forth herein upon receipt at ACI designated stores.

ภาคผนวก ข

การกระจายขนาดอนุภาคของ SiO₂ Silica HP และกากดิน

ประวัติผู้เขียน

ชื่อ	นางสาวนภัสภ์ จันทร์มี
วัน เดือน ปี เกิด	24 เมษายน 2515
ประวัติการศึกษา	สำเร็จการศึกษามัธยมศึกษาตอนปลาย โรงเรียนสาริตมหาวิทยาลัย เชียงใหม่ ปีการศึกษา 2532 สำเร็จการศึกษาระดับปริญญาวิทยาศาสตรบัณฑิต สาขาวิชาวัสดุศาสตร์ มหาวิทยาลัยเชียงใหม่ ปีการศึกษา 2537
ทุนการศึกษา	โครงการทุนบัณฑิตศึกษาภายในประเทศ ปีการศึกษา 2540 จากสำนักงานพัฒนาวิทยาศาสตร์และเทคโนโลยีแห่งชาติ (สวทช.)
ประสบการณ์	นักวิชาการอุตสาหกรรม งานบริการและทดสอบ ศูนย์พัฒนาอุตสาหกรรมเครื่องเคลือบดินเผา 2537 – 2539 เจ้าหน้าที่ประจำสำนักงานฝ่ายผลิต บริษัทนามิกิ พรีซิชั่น (ประเทศไทย) จำกัด 2539