



STUDY REPORT
ON
MARBLE AND GRANITE

Submitted to:
EXPO B2B Secretariat
Mr. Muhammad Junaid Feroz
Assistant Manager
Trade Development Authority of Pakistan,
Karachi

Ms. Afshan Uroos
Assistant Manager
Trade Development Authority of Pakistan,
Karachi

Prepared By:
Mr. Zain-ul-Abden Keerio
Assistant Manager
Trade Development Authority of Pakistan,
Hyderabad

CONTENTS:

- Introduction
- Formation of marble
- Chemical composition
- Marble formula
- Colors of marble in Pakistan
- Marble production process
- Granite production process
- Market analysis
- Proposals
- Regional country variation analysis 2014-15 & 2015-16
- Regional country variation analysis 2015-16 & 2016-17
- list of exporters
- list of importer
- list of importing markets for a product exported by Pakistan
- Suggestions & recommendations

INTRODUCTION:

The word Marble comes from Greek word Marmaros which means shining stone. Marble is a non-foliated, Granular Metamorphic Rock that is formed by the Metamorphism of Limestone and Dolostone. Marble is calcium Carbonate (CaCO_3). The term marble is also applied to serpentine rocks that can be polished to high shine. The Marble is a carbonate rock which means it has (CO_3) in Chemistry.

Marble, Onyx and Granite belong to the category of building stones widely known as Dimension Stone, These are natural stones which can be shaped in form of blocks, slabs, tiles, etc and are mostly used for monumental and decorative purposes since antiquity, various civilizations have used dimension stone in many ancient buildings and monuments that have survived to the present day. Although numerous varieties of igneous, metamorphic and sedimentary rocks are used as dimension stone, the principal rock types used are granite, limestone, marble, sandstone and slate.

Major deposits of high quality Dimension Stone available in a wide range of colors, shades and patterns could not be exploited so far due to lack of modern quarrying and manufacturing facilities. This hindered the development of marble and granite sectors. Consequently, despite being accorded the status of industry over a decade ago and other continuing efforts of Federal and Provincial Government and other stake holders as Pakistan Stone Development Company (PASDEC) and subsidiary of Pakistan Industrial Development Corporation, has initiated many projects to up lift the existing set up of Marble and granite sector. These projects are setup according to international practices, employ modern technology and focus on detail technical studies. As per plan about 10 model quarries and a number of marble cities are to be created in Pakistan. According to (PASDEC) estimates about 96,000 new jobs are to be created. These projects hold the promise to transform Pakistan's dimension sector to a great extent. CFTC (Common Facility and Trainings Centre) is also under consideration to infuse new blood and give new dimension to Pakistan's Stones Industry.

FORMATION OF MARBLE:

Metamorphic Rock of Crystalline Aggregate of Calcite and/or Dolomite. CALC–Silicate Rock with Calcium –Magnesium Silicate Mineral” (Calciphyre).

Any Calcareous and / or Dolomite Rock Capable of Taking Polish & Suitable for Decorative & Structural Purposes.

Crystalline Calcite and /or Dolomite Rock –Marble Geologically Partially Crystallized Dense Compact Lime stones – Marble Commercially
Travertine (Calcium Carbonate Precipitates) –Onyx marble
Verde Antique –Serpentine Marble

CHEMICAL COMPOSITION OF MARBLE:

Calcite & Dolomite

Carbonate of calcium

(Hardness 3-sp.grav.2.72)

Carbonate of calcium & Magnesium

(Hardness 3.5/4-Sp.Grave.2.9)

Marble Formula

(CaCO₃), 1-Calsium, 1-Carbon, 3Oxygen

COLORS OF MARBLE IN PAKISTAN

S.No.	Color	Area	Description
1	White	Muhammad Agency, Chitral, Buner,Swat,Parachinar,Gilgit, Hunza,Swabi,Malakand	Pure white: white with pink,brown and Green shades white to grey with yellowish patches, white to light grey with yellowish brown Patches;Creamy white
2	Black	Buner,Bajaur,Mardan,Bela	Deep Black :with patches of white: Black with white and golden steaks
3	Green	Swat,Swabi,Buner,Azad Kashmir and Lasbela	Dark Green,green with streak & patches of white grey and black,greenish white,
4	Pink	Nowshehra, Chitral,Lasbela	Pink with streaks and patches white, grey,redand brown :pink with fossils
5	Grey	Buner,Bajaur,Mardan,Swat,M uhammad Agency,Lasbela	Grey with white bands grey with pink, brown and green patches
6	Brown	Bunner, Swat,Kohat,Waziristan,Khuzd ar	Dark Brown with white lines ,brown with yellow Patches,light brown with fossils
7	yellow	Bunner Swat,Kohat,Waziristan,Khuzd ar	Yellow with golden patches: Yellowish golden with fossils
8	Green	Jhuli,Zard Khan,Zeh	Dark Green with layers of light green, green with streaks of white and yellow

MARBLE PRODUCTION PROCESS:

- **Introduction**

A metamorphic rock with outstanding beauty and variety, marble has been an important building material for several millennia. Thanks to the precision of modern technology, marble has become increasingly accessible and affordable for consumers. Improvements in marble manufacturing (marble "fabrication") include explosives, composite-tipped drills, diamond studded wire saws, super-fast saws, epoxy sealing and computer-controlled polishing.

- **Extraction**

During the extraction process, massive cube-like pieces of marble are cut out of the ground and transported from the quarry. To minimize the risk of cracks, fissures and other aesthetic damage to the stone, fabricators use a process known as "wire sawing" to gently separate the marble. Two 3-inch wide holes are drilled perpendicularly to each other. Once the holes connect, a heavy-duty wire embedded with artificial diamonds is fed through and secured to a flywheel, forming a loop.

A powerful engine applies massive torque to the flywheel, which circulates the diamond-embedded wire at a very fast rate. Since diamond is much harder than the marble, the friction quickly wears it away, leaving a smooth cut plane.

After wearing all the way through, another perpendicular hole is drilled and the process is repeated, cutting away the other vertical plane. For the horizontal plane, the wire saw cuts about 80 percent of the marble away, leaving a circle in the center remaining.

At this point, the wire is removed and a hydraulic excavator machine forces a wedge into the horizontally-cut planes to break the vertical plane free. Finally, a crane loads the piece onto a truck or rail car for a transport to the fabrication shop. In the fabrication shop, the piece is loaded onto a platform with hydraulic lifts underneath. Above this platform is the "gang saw," a row of dozens of 15 to 20 feet long steel saw blades connected to a crankshaft via pistons.

A giant engine turns the flywheel, which turns the crankshaft and moves the saw blade back and forth horizontally at an incredibly high rate. Each saw blade is spaced according to the desired thickness of the resulting slabs, usually 3 cm (although 2 cm is fairly common as well). As the blades saw back and forth, the hydraulic lifts push the block up into them, cutting the slabs. Once complete, two workers will gently tilt out each slab, attach a special clamp to it and use a ceiling-mounted winch to lift it into the finishing area.

- **Polishing and Sealing**

The slab is laid face down and a machine with a finely-graded, diamond-encrusted abrasive pad grinds down the surface of the slab until it is smooth and vaguely reflective. A worker (or machine, depending on the shop) then sprays on a uniform coat of epoxy sealer onto the surface and leaves it to dry for 48 hours. Heat lamps can expedite this process. Once dry, the

slab is flipped over and the process repeated for the opposite side. Polished and sealed, the finished slabs then ship out to retailers and distributors.

- **Water Jet Cutting and Wet Sawing**

At the retailer's show room, slabs are displayed in giant, iron oxide-coated easels for customers to view. After choosing a slab(s), the customer gives the dimensions of his project (kitchen counters, ballroom floor or bathroom) to the retailer, who maps the shapes onto the slab itself. To cut these pieces out, fabricators traditionally used a process called "wet sawing" where circular saws coated with tungsten carbide cut through the slab while continuous streams of water spray on the blades to keep them from overheating. Today, most fabricators use a technology called "water jet cutting" to cut pieces, make holes for appliances and create beveled edges. In water jet cutting, water is pressurized to 60,000 psi and allowed to shoot out in a concentrated stream. Traveling at 2.5 times the speed of sound, the stream mixes mid-air with a powdered abrasive (e.g. aluminum oxide or garnet) before striking the marble.

The result is a precise hyper-erosion that can be used for two-dimensional and three-dimensional applications alike. Due to this degree of precision (in the micrometer range), a computer controls the entire cutting process.

GRANITE PRODUCTION PROCESS:

- **Introduction**

Granite is formed underground by the cooling of magma. Deep within the earth, beyond the mantle layer, lies a deep layer of molten rock. As the rock gets closer to the surface, it also cools, creating internal igneous rocks. One of these rocks is granite. Granite can be a mixture of mainly quartz and feldspar but also may contain mica.

- **Extraction**

There are three main ways to extract the stone:

- The most common method is the production by the blast. A deep hole is bored by drilling method in a rock, where the charge is laid with following blasting. Among the breakaway pieces of rock the largest boulders are selected, which are then sawn into slabs.
- The second method of granite extraction is the method of breaking off with the air bag. It is similar to the first method so that the rock is also drilled with insertion of reservoir being inflated with air under high pressure
- Third, the most expensive method of granite extraction – is the method of stone-cutters - now the most popular in the West. Quarrying by this method provides the possibility to completely avoid micro cracks and gives the most rational way to mine the deposit.

- **Processing**

Once blocks of stone reach the processing facility, they are cut down into smaller more manageable pieces. For tile, this means cutting the stone into billets before polishing. For slab materials, gang saw is used for further processing. A gang saw works has many adjustable blades that allow for the thickness of the slabs to be adjusted. The gang saw can cut the entire block of stone into slabs at one time. More delicate materials may require the use of a diamond wire saw to gently cut one slab at a time with few traumas to the stone.

The most recent technology involves multi-wire gang saws which have the potential speed production on exotic materials exponentially. After slabs are cut on the gang saw, they are moved one at a time to the polishing line, where they are laid horizontally on a large conveyer type line called a polishing line.

There, they pass under polishing heads which begin with very coarse diamond abrasives, and then move to finer and finer grit abrasives, just like sanding wood. Travertine slabs and some marbles, will receive a cementitious or epoxy compound to fill the natural voids of the stone.

Part of the way through this line, slabs of granite, marble, and onyx will receive a coating of a resin treatment which will fill in any pits or micro fissures which are inherent to the stone in order to make the final surface easier to clean.

Most of the excess resin is removed by further polishing, with only 1% remaining on the finished surface. For materials where the final surface is to be honed, the process will stop with a lower grit abrasive than materials with a polished surface. Slabs are bundled together and braced with a wooden framework, custom built to ensure the slabs stay upright during the shipping process.

MARKET ANALYSIS:

Marble is included in the list of largest minerals extracted among others. It is used for both construction purposes and Handicrafts manufacturing, whereas, Onyx which is a semitransparent and generally used by handicrafts manufacturing industry. Major export markets for these handicrafts are Central Asian Republics, United States of America and Australia.

The domestic market also carries a great untapped potential for these handicrafts. Availability of high quality Marble reserves in Pakistan in great quantities and the demand of its products in the export markets i.e. European Union countries, Central Asian countries etc. make this sector highly attractive. Foreign tourists are the main customers of the products made of marble. Marble and Granite industry in Pakistan has total estimated reserves of around 160.1 million tons located mainly in Balochistan, Khyber Pakhtunkhwa and Sindh.

Around 90 percent of the total reserves are believed to be in KPK but several of the marble sites in the area are facing closure due to law and order situation, load shedding, improper infrastructure and militancy in the area. Buner-Mardan gray marble, Chitral, Dir, Mansehra black granite and Shangla are high potential sites for investment in marble

PROPOSALS

- For conducting overseas market potential survey.
- Propose a collective/group participation of private companies involved in quarrying processing and trading/export of stones in at least in four international Stone fair in Pakistan.
- Propose organizing an international stone fair in Pakistan.
- Propose scheme for bringing in overseas Buyers to international fairs being held in Pakistan as well visit to quarries, processing plants.

These activities shall have to be under taken in the beginning of first year of implementation as by then industry will have become self sufficient mechanization of Quarries will have been done modern processing plants will have been established and a number of value added products will be available from the manufacturing units. The activities can be entrusted so that in ten years period Pakistan rises to become one of the top ten stone exporting countries in the world.

REGIONAL COUNTRY VARIATION ANALYSIS

Value in 000 \$

S.No.	Commodity	Year	Export	Share %	Change
1	MARBLE & STONE	2015-16	60,453	0.29	(8,190) (11.93%)
2	MARBLE & STONE	2014-15	68,643	0.29	

Source: Statistical Section, TDAP Karachi

PRODUCT INCREASE

Value in 000 \$

S.No	COUNTRY	2015-16	2014-15	VARIATION
1	KOREA, REP. OF	1,461	792	669
2	U.A.E.	843	720	123
3	ITALY	672	573	99
4	AFGHANISTAN	638	528	110
5	U.S.AMERICA	206	168	38
6	OMAN	129	111	18
7	IRELAND	79	58	21
8	KENYA	59	18	41
9	AUSTRALIA	38	26	12
10	JAPAN	23	19	4
11	SINGAPORE	19	8	11
12	CANADA	10	4	6
13	UNITED KINGDOM	7	7	-
14	PORTUGAL	3	-	3
15	GERMANY	1	-	1
TOTAL		4,188	3,032	1,156

Source: Statistical Section, TDAP Karachi

PRODUCT DECREASE

Value in 000 \$

S.No	COUNTRY	2015-16	2014-15	VARIATION
1	CHINA	40,585	47,126	(6,541)
2	INDIA	13,286	14,778	(1,492)
3	SAUDI ARABIA	957	1,088	(131)
4	BANGLADESH	327	368	(41)
5	VIET NAM	182	282	(100)
6	QATAR	147	155	(8)
7	BAHRAIN	50	101	(51)

8	SRI LANKA	49	73	(24)
9	KUWAIT	33	157	(124)
10	GREECE	25	43	(18)
11	U.R.OF TANZANIA	13	16	(3)
12	SOUTH AFRICA	10	36	(26)
13	HONG KONG	7	116	(109)
14	THAILAND	6	243	(237)
15	SPAIN	4	71	(67)
16	MALAYSIA	1	4	(3)
17	MOZAMBIQUE	-	1	(1)
18	POLAND	-	4	(4)
19	TURKEY	-	6	(6)
20	NIGERIA	-	7	(7)
21	EGYPT(U.A.R.)	-	18	(18)
22	OTHER COUNTRIES	583	918	(335)
TOTAL		56,265	65,611	(9,346)

Source: Statistical Section, TDAP Karachi

REGIONAL COUNTRY VARIATION ANALYSIS

Value in 000 \$

S.No.	Commodity	Year	Export	Share %	Change
1	MARBLE & STONE	2016-17	48,391	0.26	(7,195) (12.94%)
2	MARBLE & STONE	2015-16	55,586	0.29	

Source: Statistical Section, TDAP Karachi

PRODUCT INCREASE

Value in 000 \$

S.No	COUNTRY	2016-17	2015-16	VARIATION
1	INDIA	14,662	12,032	2,630
2	BANGLADESH	426	309	117
3	U.R.OF TANZANIA	41	13	28
4	MALAYSIA	27	1	26
5	QATAR	166	144	22
6	INDONESIA	15	-	15
7	CANADA	23	10	13
8	U.S.AMERICA	118	106	12
9	BAHRAIN	61	50	11
10	UNITED KINGDOM	18	7	11
11	AFGHANISTAN	610	600	10
12	TURKEY	10	-	10
13	OMAN	116	108	8
14	JAPAN	30	23	7
15	COLOMBIA	6	-	6
16	MOZAMBIQUE	2	-	2
17	FRANCE	1	-	1
18	GERMANY	2	1	1
19	POLAND	1	-	1
20	SLOVENIA	1	-	1
21	PORTUGAL	3	3	-
TOTAL		16,339	13,407	2,932

Source: Statistical Section, TDAP Karachi

PRODUCT DECREASE*Value in 000 \$*

S.No	COUNTRY	2016-17	2015-16	VARIATION
1	CHINA	29,087	37,456	(8,369)
2	KOREA, REP. OF	770	1,346	(576)
3	SAUDI ARABIA	359	930	(571)
4	ITALY	409	567	(158)
5	VIET NAM	84	182	(98)
6	U.A.E.	746	804	(58)
7	IRELAND	45	79	(34)
8	GREECE	-	25	(25)
9	KENYA	36	59	(23)
10	KUWAIT	14	33	(19)
11	SINGAPORE	-	19	(19)
12	SOMALIA	-	13	(13)
13	SOUTH AFRICA	-	10	(10)
14	HONG KONG	-	7	(7)
15	THAILAND	-	6	(6)
16	AUSTRALIA	34	38	(4)
17	SPAIN	2	4	(2)
18	SRI LANKA	47	49	(2)
19	OTHER COUNTRIES	419	552	(133)
TOTAL		32,052	42,179	(10,127)

Source: *Statistical Section, TDAP Karachi*

LIST OF EXPORTERS:

HS Code: 251512

Value in 000 \$

S.No	Exporter	Exported Value in 2012	Exported Value in 2013	Exported Value in 2014	Exported Value in 2015	Exported Value in 2016
1	World	1394743	1740892	1467218	1304243	1247265
2	Turkey	650020	879551	756444	712259	731122
3	Italy	172646	206213	206029	164274	161050
4	Spain	139411	171613	126741	106620	71770
5	Iran, Islamic Republic of	83873	60416	53518	58399	69300
6	India	41495	40768	35073	28464	29138
7	Pakistan	36027	50259	43250	39376	27735
8	Portugal	33831	40559	37441	27631	17193
9	Macedonia, The Former Yugoslav Republic of	11847	17165	19274	16710	16523
10	Viet Nam	3646	436	139	0	14805
11	Greece	14057	22660	22633	14114	13731

LIST OF IMPORTERS:

S.No	Importers	Exported Value in 2012	Exported Value in 2013	Exported Value in 2014	Exported Value in 2015	Exported Value in 2016
1	World	1715133	1879828	1838334	1611872	1528370
2	China	1162461	1300046	1248250	1026722	1036842
3	India	203498	225394	227169	294622	213644
4	Algeria	19964	24274	25363	27421	29333
5	Indonesia	22852	27162	27533	28241	19902
6	Taipei, Chinese	22801	25760	32498	20898	18407
7	Italy	16903	17966	19579	19900	17793
8	Thailand	12350	10952	11917	16445	16678
9	United Arab Emirates	10139	7892	3679	6256	15416
10	Lebanon	28004	24393	30453	18209	14086
11	Qatar	4907	4459	1492	1353	12137

LIST OF IMPORTING MARKETS FOR A PRODUCT EXPORTED BY PAKISTAN:

S.No	Importing Markets	Exported Value in 2012	Exported Value in 2013	Exported Value in 2014	Exported Value in 2015	Exported Value in 2016
1	World	36027	50259	43250	39376	27735
2	China	31776	46181	38379	35486	24207
3	Saudi Arabia	1018	751	972	648	660
4	Italy	305	736	786	499	618
5	Korea, Republic of	84	38	193	127	557
6	Afghanistan	407	31	258	309	379
7	United Arab Emirates	418	207	611	365	349
8	United States of America	230	221	96	133	217
9	Lebanon	245	444	412	231	139
10	Bangladesh	107	167	33	169	87
11	Ireland	22	30	39	75	79

Sources: ITC calculations based on UN COMTRADE and ITC statistics.

SUGGETIONS & RECOMMNDATIONS:

- Training Centers
- Warehousing in foreign countries.
- Cluster Development.
- Study Tour.
- Freight Rebate scheme for the Baluchistan based exporters.
- To develop new products and promote export To organize seminars and talk shows to disseminate Knowledge and create country wide entrepreneur awareness
- To launch a Dimension stone Magazine/Research journal specifically focusing on products, markets, issues and solutions of this industry.