



# **Indian Minerals Yearbook 2019**

**(Part- III : Mineral Reviews)**

**58<sup>th</sup> Edition**

## **30.21 SLATE, SANDSTONE & OTHER DIMENSION STONES**

**(FINAL RELEASE)**

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**August, 2021**

# 30-21 Slate, Sandstone & Other Dimension Stones

**S**late, sandstone, limestone and quartzite are the principal rock types used as dimension stones other than granite and marble. India is endowed with abundant resources of these types of dimension stones which are increasingly used by domestic consumers. These stones are also important export commodities. India is one of the largest producers of dimension stones in the world.

## 1. SLATE

Slate is a fine-grained, very low-to-low metamorphic rock possessing well-developed fissility (splitting attitude) tendencies that are parallel to the planes of slaty cleavage. It is formed by the metamorphism of pre-existing clay rocks, such as, claystone, shale or siltstone. The most remarkable feature of this rock is that it has cleavage planes that are well-marked which enable it to be split manually or mechanically into relatively thin slabs. Slate is a low-cost decorative stone used for exterior and interior decoration of buildings. It is significantly used in roofing. It is also used as school slate and also as building dimension stone. The aesthetic value of slate matches that of other dimension stones, granite and marble. Slate has emerged as a low cost alternative to granite and marble which are comparatively expensive. The exports of slate have increased over the period and this has brought a sense of reckoning to Slate Mining Industry of the country. Micaceous and chlorite slates are generally preferred among many slate stone varieties.

## OCCURRENCES

The Aravalli Mountain ranges in Rajasthan and Haryana; rock assemblages under Kadapa System in Andhra Pradesh and Tamil Nadu; and Himalayan region in Northern India are the regions where slate deposits along with other metamorphosed products are abundantly known to be present. The availability of slates has also been reported from Madhya Pradesh, Haryana, Himachal Pradesh, Jharkhand, Andhra Pradesh, Rajasthan, Uttarakhand, Bihar and Gujarat.

## RESERVES/RESOURCES

Attempts to consolidate and prepare an authentic inventory of slate are underway. However, the total reserves resources of slate as per NMI database based on UNFC system (as on 01.04.2015) are placed at 22.9 million tonnes under Unclassified grade. Reserves/Resources are located in Andhra Pradesh & Haryana (Table- 1).

## EXPLORATION & DEVELOPMENT

The exploration & development details, if any, are covered in the Review on "Exploration & Development" under "General Reviews".

## PRODUCTION

As per Govt of India Notification S.O. 423(E), dated 10<sup>th</sup> February 2015, 'slate' has been declared as 'Minor Mineral' hence the producers report the production data directly to the respective States and not to IBM. However, efforts were made to collect this information through correspondence with the State Directorates of Mining and Geology of individual States or visiting their websites. But data only a few States could be collected. All possible information/data that could be gathered has been presented in this Review.

Statewise production of slate is furnished in Table-2.

**Table-2: Statewise P roduction of Slate**

(In tonnes)

State	Year		
	2016-17	2017-18	2018-19
Andhra Pradesh	-	42190	-
Himachal Pradesh	1539	2775	2859
Rajasthan	-	1900	-

*Source: As received from State DGMs and their websites.*

*Note : " - " NA*

**Table – 1 : Reserves/Resources of Slate as on 1.4.2015**  
(By Grade/States)

(In '000 tonnes)

Grade/State	Reserves			Remaining Resources					Total resources (A+B)		
	Proved STD111	Probable STD121 STD122	Total (A)	Feasibility STD211	Pre-feasibility STD221 STD222	Measured STD331	Indicated STD332	Inferred STD333		Reconnaissance STD334	Total (B)
<b>All India : Total</b>	<b>19619</b>	<b>667</b>	<b>20286</b>	<b>-</b>	<b>-</b>	<b>1075</b>	<b>-</b>	<b>1511</b>	<b>-</b>	<b>2586</b>	<b>22872</b>
<b>By Grade</b>											
Unclassified	19619	667	20286	-	-	1075	-	1511	-	2586	22872
<b>By States</b>											
Andhra Pradesh	109	667	776	-	-	1075	-	1511	-	2586	3362
Haryana	19510	-	19510	-	-	-	-	-	-	-	19510

Figures rounded off

## USES AND SPECIFICATIONS

There are two main uses of slate as a natural stone in building work: 1) for roofing in the form of roofing tiles and 2) for flooring in the form of tiles and for cladding purposes.

For roofing tiles, the slate stone should be exfoliated easily and should be free from minerals like iron sulphides or carbonates which after a period of time could cause corrosion and staining. For cladding or flooring purposes, the slate stone should withstand the impact of the cutting processes involved for producing required sizes, polishing or smoothening process by machines and should not peel off during the process of fixing or laying. Bureau of Indian Standard has laid down Standard IS: 6250-1981 (First revision; reaffirmed 2008) namely, specification for roofing slate tiles with respect to requirement of dimensions, physical properties and workmanship of slate tiles used for sloped roof covering.

## 2. SANDSTONE

Sandstone is a sedimentary rock largely made up of sand grains in size ranging from 2 mm to 120 mm of varying compositions. The sand may consist of grains of quartz, feldspar and other detrital minerals with interstitial cementing material. The composition of sand particles and the cementing material by and large defines the colour of sandstone while the mode of formation decides the thickness of bed which gives rise to various types of sandstones.

The colour of sandstone may range from dark red to brown, earthy to buff, white, yellow and a number of other shades. The pattern of the sandstone depends upon the thickness of bed. Sandstone produced in the country is being marketed as Vindhyan Red, Rainbow, Teak, Modak, Bundi, Bansi Pink, Mandana, Dholpur Cream, etc. The sandstone may occur as massive, thick, non-splittable bands or thin beds or layers that can be split by applying slight pressure.

## RESERVES/RESOURCES

Occurrences of sandstone in India are spread across Andhra Pradesh, Assam, Bihar, Gujarat, Haryana, Madhya Pradesh, Meghalaya, Mizoram, Karnataka, Odisha, Punjab, Rajasthan, Uttar Pradesh, Tamil Nadu and West Bengal.

The reserve/resource estimation has not been considered important because of its abundance and easy availability. Hence, there is no comprehensive inventory of sandstone. However, the Centre for Development of Stones (CDOS), a 'Government of Rajasthan Undertaking' has reported estimated reserves of sandstone at over 1,000 million tonnes in the country. Huge deposits of sandstone in Rajasthan are associated with Vindhyan and Trans-Aravalli Formations, exposed over an area of nearly 35,000 sq. km covering districts of Dholpur, Bharatpur, Karauli, Sawai Madhopur, Tonk, Bundi, Jhalawar, Kota, Bhilwara and Chittorgarh. It is also found scattered in the districts of western desert plain in the districts of Jodhpur, Churu, Bikaner and Nagaur. Splittable sandstone deposits are confined to an area of 16,000 sq. km, out of which 10,000 sq. km lies in eastern and south-eastern Rajasthan and 6,000 sq. km in western Rajasthan.

In Gujarat, fine to medium-grained sandstone of varying colours ranging from white, light-purplish, reddish-brown, cream to yellow are found in the district of Kachchh. A brownish-yellow sandstone occurs near Chabari and Mainapara in Bhachau tehsil. The sandstone at Rampur, Katada-Roha and Rajoda Dungar near Mangwana in Nakhtrana tehsil is cream coloured and is fairly hard. Extensive deposits are found around Songir, Naswadi, Ghautoli, Namaria and Lachharas in District Vadodara.

The Vindhyan and Satpura Mountains in Madhya Pradesh have vast resources of sandstone. The red, cream and white sandstone are being quarried extensively in Panna and Shivpuri districts and in many areas near Jabalpur.

In Uttar Pradesh, sandstones suitable for making slabs and tiles are located in Agra, Mirzapur, Lalitpur, Allahabad and Sonbhadra districts. The sandstone of Lalitpur district is yellow, light green and maroon and takes good polish. The sandstone in Lalitpur occurs in Madanpur and Rampura (near Deogarh) areas and is traded under the commercial name Royal Gold, Beach Sand and U.P. Green. The sandstone of Agra occurring in Tatpur area is red and mottled and is used for interior as well as exterior flooring and cladding. In Mirzapur and Sonbhadra areas, good quality buff to pale and creamish sandstone is available.

The felspathic sandstone occurring with the coal seams as overburden is also used as building stone. The Kamthi Sandstone occurring in and around Tehsil Saoner, District Nagpur in Maharashtra is being quarried and is used as building stone.

### EXPLORATION & DEVELOPMENT

The exploration & development details, if any, are covered in the Review on "Exploration & Development" under "General Reviews".

### PRODUCTION

Sandstone being building stone comes under 'Minor Mineral' as defined in Clause (e) of the Section 3 of MM(DR) Act 1957, hence the producers report the production data directly to the respective States and not to IBM. Production data for sandstone is not available.

### 3. DIMENSION LIMESTONE

The limestone which is used as dimension stone differs from the limestone used for cement making or for any other industrial purpose in two ways — firstly, chemical composition and secondly, the mode of occurrence. In both the types, the major constituent is calcium carbonate, but, very high silica content gives limestone sufficient hardness to be utilised as a dimension or building stone. The industrial limestone occurs as massive formation with less intercalations while in case of dimensional limestone, thin-bedded deposits are preferred. Limestone which is compact and amorphous in texture is known as flaggy or splittable limestone and is quarried in the form of thin slabs ranging in thickness from 12 mm to 50 mm in ready-to-use form. Statewise production of limestone slabs used as dimension stone is furnished in Table-3

**Table-3: Statewise Production of Limestone Slabs**

(In sq m)

State	Year		
	2016-17	2017-18	2018-19
Andhra Pradesh	17900798	23723895	-
Telangana	3446828	3806327	3674418
Rajasthan	3925951	3653001	-

*Source: As received from State DGMs and their websites.*

*Note : " - " NA*

Limestone has been used since ancient times for construction of houses, flooring and for various other building purposes. In recent times, the use of limestone has increased manifold mainly for interior flooring, as cobble stones and for decorative purposes in combination with other stones because of its availability in a ranged of colours and shades. Depending upon the place of origin of limestone and its colour, various types of nomenclatures have been used in the trade for limestone, such as, Kadapa Stone, Shahabad Stone, Kota Stone with different shades and colours (Kota Blue, Kota Brown, etc.), Kachchh Stone, Miliolitic Limestone, etc.

### OCCURRENCES

Occurrences of dimension limestone have been reported from several regions across various States, such as, Shahabad Stone of Vijapura at Kalaburagi and Belagavi districts in Karnataka; and 'Kadapa Stone' of Kurnool at Anantapur and Guntur districts and 'Tandur Stone' of Kadapa district in Andhra Pradesh, etc. Other coloured well-known limestones are from Bethamcherla, Tadipatri & Macherla areas in Andhra Pradesh and Nereducherla & Muddimanikyam in Telangana. Occurrence of 'Milliolitic Limestone' from Saurashtra region, 'Yellow Limestone' in Kachchh district of Gujarat, 'Kota Limestone' in Kota district and 'Yellow Limestone' in Jaisalmer district, Rajasthan have also been reported from across the country.

Rajasthan is richly endowed with the occurrence of greenish-grey 'Kota' limestone. The Kota stone has gained tremendous popularity and is widely used for flooring and cladding purposes. The important deposits of limestone are in Kota, Jhalawar, Chittorgarh. and Jaisalmer districts, Rajasthan. Kota, Jhalawar and Chittorgarh are the major districts that produce dimension limestone in the State. Extensive limestone deposits are found in the Upper Stage of the Lower Vindhyan and these limestone varieties have good potential to be used as cement-grade limestone as well as flooring stone. Certain portions of the limestone having splittable form are used extensively as flooring stones. Occurrences of limestone in the north-south belt from Dalla-ka-Khera to Nimbahera which extend into Madhya Pradesh covering a distance of about 70 km have been

established. It is fine-grained, thinly bedded and has a total thickness of about 150 m. At a few places, the major portion of the limestone deposit is suitable for cement making but there are pockets, containing splittable forms that can be used for building and flooring purposes directly.

Occurrences of yellow limestone deposits in Jaisalmer are of Jurassic Age and is found in Bada Bag, Mool Sagar and Kanod villages of Jaisalmer. It contains 42 to 51% calcium oxide and has a thickness of about 3 m. It is quarried in the form of blocks and can be sawed into slabs and tiles. It is also termed as yellow marble as it takes reasonably good polish.

Flaggy limestone deposits of Jhalawar and Ramganjmandi, Kota area belong to Lower Vindhyan Group and are available in plenty at Sarola Kotri Chitawa and Khokhriya-Khurd areas. Extensive deposits are available near Ramganjmandi, Aroliya and Parolia areas. Ramganjmandi and Jhalawar Road are the main railway stations from where the splittable limestone produced is dispatched to various parts of the country. In the last few years, export market of this limestone which is popularly known as 'Kota Stone' has been vastly significant.

## **EXPLORATION & DEVELOPMENT**

The exploration & development details, if any, are covered in the Review on "Exploration & Development" under "General Reviews".

## **USES & SPECIFICATIONS**

Application of Kota Stone ranges from interior flooring, wall cladding to exterior use in paving and facades for building of all kinds and types.

The Kota Stone has a natural split non-slip surface. Massive, dense and fine-grained varieties are generally durable as these are not porous. These are tough and have a crushing strength of 17.8 kg/mm<sup>2</sup> and a high compressive strength of over 2,189 kg/cm<sup>2</sup>. Abrasion value of Kota Stone is 18.12 to 18.32 and it has a high resistance to delamination and failure under freezing and thawing conditions.

Bureau of Indian Standards has prescribed Specification for Limestone (Slab & Tiles) as IS : 1128 - 1974 (First Revision, reaffirmed 2008).

## **4. OTHER DIMENSIONAL STONES**

In addition to the dimension stones already described, other dimension stones are also quarried and used for the construction of houses and other building purposes.

In Odisha, Karnataka, Goa and in parts of coastal States, laterite is quarried in huge quantities. It is utilised as bricks in the construction of houses and pavements. Huge deposits of basalt in Maharashtra, Karnataka and Gujarat are used as building stones since ancient times. Quartzite bands occurring along with phyllite schists are also utilised for building purposes.

In addition, stone aggregates, such as, broken and sized pieces of limestone, dolomite, quartzite and sandstone are mixed either with cement for building and road-making purposes or with asphalt for mending road. To utilise the huge waste generated during mining and processing, a new variety of man-made stone 'Terrazo' has been developed, which is composed of stone chips set in cement, epoxy or polyacrylate and then polished. The Terrazo is an economical alternative to solid marble slabs or tiles.

## **5. FELSITE**

Felsite is a fine evenly-grained acid or intermediate igneous rock, usually occurring as dykes and veins in country rocks and in the parent plutonic mass. BIS has prescribed the specification IS:10874-1983 (reaffirmed 2010) for felsite grinding media and liner stones. Felsite has architectural, industrial and antiquity uses. As per GOI Notification S.O.423(E), dated 10.2.2015, felsite has been declared as 'Minor Mineral', hence the production beyond January, 2015 is not available with IBM. However, the production value of felsite was provisionally estimated at ₹ 13.01 crore during 2015-16.

## **TRADE POLICY**

As per the Export-Import Policy announced for the period 2015-20; and the Foreign Trade Policy thereunder, the imports of slate blocks or slabs whether or not roughly trimmed or merely cut are restricted under Heading No. 2514.

Import of crude or roughly trimmed/cut blocks or slabs of sandstone and other monumental or building stones, viz, pakur stone, stone boulders, and others, are restricted under Heading no. 2516. However, sets of curbstones and flagstones of natural stone (except slate) under Heading no. 6801 and worked monumental building stone (excluding slate), tiles, cubes and similar articles of natural stone including slate, under Heading No. 6802 can be imported freely. Worked slate and articles of slate or of agglomerated slate under Sub-heading 6803 can also be imported freely. Exports of stone aggregates which are restricted under Chapter 25 of ITC (HS), 2015-20, Schedule 2-Export policy, are permitted to be exported to Maldives subject to ceiling limits. The limits are 5.5 lakh tonnes and 6 lakh tonnes for the years 2015-16 and 2016-17, respectively. The annual ceilings are monitored by CAPEXIL and is subject to exporters obtaining appropriate clearances.

## **FUTURE OUTLOOK**

Slate is mostly used as a roofing material, but other uses like cladding and flooring tiles are also gaining momentum. Slate occurs widely in the country and detailed study has to be conducted to quantify the resources. The demand for dimension stones including sandstone & others and stone products is anticipated to grow at around 15%. A similar growth is also expected in exports.

The demand for artifacts, especially carved work is on the rise all over the world. India with its rich tradition of craftsmanship and trained artisans can embark upon the world market.

Improved quarrying, finishing & hauling technology, availability of greater variety of stones and the rising cost of alternative construction materials are among the factors that suggest that the demand for dimension stones in future would see steady and consistent growth.