

# THE RICH TRADITION OF POWDER METALLURGY IN INDIAN SYSTEM

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**Abstract**— The powder metallurgy is an important branch of metallurgy. The applications of the metal powders can be seen in various fields like automobile, defense, atomic energy and 3-D printing. Production of metal powders, their compaction, and fusing of the powders are significant processing stages in the powder metallurgy in the present times. However, there has been the application of powder metallurgy techniques in traditional Indian system since ancient times. The references suggest Indians have had the knowledge of converting metal in to powdered form traditionally for a very long time before this process was introduced in modern world. The ancient Indian scriptures and texts like 'Shukraniti' also provide indications to the use of gun powder. The Ayurvedic texts have procedures and explanations for preparing the powder of metals like gold, silver, iron, copper. Even today these procedures are followed by the Ayurvedic doctors in India. As practical application in medicine is evident today, this technology has been perceived to have its boundary constrained to the medical sciences. However, it is not so, there are references in ancient texts that suggest its application in various fields. This technology is actually the science of the production of metal powders using herbals. The purpose of this article is to reveal the rich tradition of powder metallurgy in Indian scriptures and its applications.

**Index Terms**— Bhasma, Indian Metallurgical Tradition, Metal Powders, powder metallurgy

## 1 INTRODUCTION<sup>[1]</sup>

The metal powder is called 'Bhasma' in the Indian texts traditionally. In general the term 'Bhasma', is used to indicate the ash which is used in the religious rituals. In Vedic tradition a ritual called 'Sandhyavandam' is mentioned. This was one the rituals performed on daily basis. However, interesting part considering our context is 'Bhasmavidhi' the process to spread the 'Bhasma' or powder on the body; this was the part of ritual to be carried out prior to 'Sandhyavidhi'. The 'Bhasma' was produced using different methods and its name suggested the method by which it was produced.

- i. Agniriti Bhasma- The 'Bhasma' that can be produced with help of fire (Agni).
- ii. Vayuriti Bhasma- The bhasma that can be manufactured with the help of air (Vayu).
- iii. Vyomoti Bhasma- The Bhasma which can be produced with the help of Mercury (Vyom).
- iv. Stalamiti Bhasma- The Bhasma that can be prepared with the help of soil (Sthala).

The purpose of 'Bhasmadharanvidhi' is to purify human body. This is primary example of utilization of metal powder in daily lives of people in Vedic tradition. Apart from that the books like 'Rasaratnakara', 'Rasajalnidhi', 'Rasaratnasamucchaya' contain the procedure to prepare metal powders. Before going into the details, the understanding of concepts like 'Jarana' and 'Marana' in alchemy is important.

## 2. SWALLOWING- KILLING AND BHASMIKARAN PROCESS

The terms 'Jarana' (Swallowing) and 'Marana' (Killing) are crucial before proceeding to 'Bhasmikaran' (conversion of metals to the powder) process.

- i. Jarana- Jarana or Swallowing is the the process

which indicates the absorption of one metal in to another metal (especially mercury).

- ii. Marana- Marana or killing is the process to turn metal into the ashes with enhancement in the qualities.
- iii. Bhasmikaran- Bhasmikaran is also the process of turning the metal in to the powder. The difference between the Marana and Bhasmikaran is in the context of grain size of the powder.

The Indian society has been viewing these concepts as miracles or magic, but they are processes related to powder metallurgy. 'Rasashastra' is the term used for metallurgy in Indian traditions. 'Ras' also means mercury. The researchers also term 'Rasashastra' as chemistry. The ancient Indians used mercury extensively for various applications like medication, energy source, fuel, etc. Hence, mercury can be considered to be the epicenter of the Indian metallurgical practices. Many scriptures and texts available today on ancient metallurgy are related to use of mercury and its processing. Bhasmikaran is the last stage in preparation of the metal powders. It is an interesting task to study the process of 'Bhasmikaran' and related processes from ancient texts. The term 'Bhasma' is generally considered as sacred ashes. Even today any person with holistic believes has faith in these practices. But we have broadened our perspective as these rituals have some technology hidden within them.

Ayurveda is an established branch of medicine even in this modern age. Thus, it is evident the chants and prayers can suggest something more scientific or related to technology along with improving the spiritual belief. In Ayurveda there are two applications of 'Bhasma', to consume it as a medicine and to spread

it on body externally. The second operation is more interesting because the purpose behind applying it on the body is to purify the body. This is possible only if the 'Bhasma' penetrates the layer of human skin. Thus, it can be inferred that the 'Bhasma' should be very fine i.e. the particle size must be very small. The ancient texts have explanation for preparing the metal powders and their varied applications. The process described is very critical to understand and must be performed precisely to obtain the expected results. The most difficult task in entire powder making process is to collect all the required herbs and other scarce ingredients.

Following are some the important books that provide vital information and give idea about the powdered metals.

### 3. ANCIENT TEXTS ON POWDER METALLURGY:

Sr.No.	Name of Book	Author/Editor
1	Rasratnakara	Dr.Swaminath Mishra
2	Rasratnasamucchaya	Vagbhat
3	Shilpratna	Srikumara
4	Rasendrasar	GopalKrishna Bhat
5	Raskamdheni	Chudamani Mishra

Table No.1) Book and Authors

However, the orthodox Indian mindset considers the mentioned books are related to 'Ayurveda' only. No doubt, Ayurveda uses the metal powders as a medicine. But it should be viewed from the angle of the metallurgy as well.

'Loha', is the word used for the metals in Indian tradition. There is no any classification based on ferrous and non ferrous like today. The term 'Lohabhasma' always refers the metal powder. It is interesting to discuss the preparation of metals powder.

### 4. ANCIENT METHODS USED TO PREPARE METAL POWDERS

#### 1) Powder of Gold.

Any Metal powder can be prepared by either using the Sulphur or Mercury. The powder prepared by using Mercury is superior in the quality than the powder prepared using Sulphur. The gold powder can be prepared by heating the mercury and gold with lemon juice in Gajputa (A type of furnace)

#### 2) Powder of Silver

The Silver powder can be prepared with the help of Mercury, Lemon juice, Sonamukhi and Harital (types of herbs). Again for heating purpose, Gajput is suggested.

#### 3) Powder of Copper

To convert the copper into powder form, a copper plate should be coated with the mixture of Mercury, Sulphur and Lemon juice and should be kept in the 'Gajput'. In another method the cow urine is also suggested to be used along with above apparatus.

#### 4) Powder of Iron

'Rasratnasamucchaya' classifies the iron in to the following types depending on the properties.

Sr.	Ancient Name	Modern Name
1	Kant Loha	Wrought Iron
2	Tikshna Loha	Carbon Steel
3	Munda Loha	Cast Iron

Table No.2) Classification of Iron

The Iron powder can be prepared with the help of sand, ghee, cow urine, Triphla (The powder made of special herbs and Lemon juice. Again, for the purpose of heating Gajput is suggested. In some processes application of Mercury and Sulphur is also mentioned.

#### 4.1) Varitar Bhasma

The term 'Varitar Bhasma' is very interesting. In Sanskrit Vari means water and Tar means to float. The term 'Varitar' Bhasma' indicates the powder which can float on the surface of water. The approach suggests the density of the particles of the metal powder

#### 5) Powder of Tin.

The tin powder can be prepared by heating of tin plate (which is coated by paste of milk, harital (bark of tamarind and peepal tree) in' Laghuputa. In another method it can be prepared with Harital.

#### 6) Powder of Lead

Lead powder can be prepared with the help of Mercury and other herbs. The 'Yantra' used in this process is called as 'Bhrashtayantra'. The red colored lead powder is always good from the quality aspect.

#### 7) Powder of Brass

Ritika and Kaktundi are the two types of brass in Indian tradition. The brass powder can be prepared by applying the mixture of Lemon juice, and Sulphur on brass plate and heating it in to the Gajputa.

#### 8) Powder of Bronze

The Bronze in Saurashtra region is considered as quality bronze. To convert it into the metal powder; Lemon juice, Sulphur and Harital shall be applied on bronze plate and it should be heated in the 'Gajputa'.

This is some description about the preparation of metal powders using ancient techniques. There is a little variation in the processes, but the core part is common in all the texts. A fact shall be mentioned here, that in the ancient techniques of the powder metallurgy natural resources like various herbs, cow milk, cow urine etc. have been utilized. They are easily available and hence the problem of pollution can be avoided. Sulphur is a common ingredient. In today's era also, the Aurvedic doctors suggest the consumption of the metal powders. Naturally the questions can be asked, where is the technical application of the metal powders in the ancient times? In present practices there are different applications of powder metallurgy in the fields of 3D printing, refractory products, automobile sector etc. The Interesting mentions about application of powder metallurgy in ancient time can be seen in a book called as 'Shukraniti'. A French researcher Oppert Gustav has studied the above Sanskrit text and put forward many significant facts. A book named as 'Jamdagnya Dhanurveda' also provides these references. [4]

### 5. METAL POWDERS IN ARMOURS.

Majmalu-t-Tawarikh provides the reference of the elephant shaped machines and filled with explosives (metal powders, gunpowder etc.) which used to be employed on the battlefield to kill the enemy. [5] Oppert Gustav's accounts provide the

**classical information about the preparation of the gunpowder in the India. The ancient Indians were expert in the production of the gunpowder by using the following ingredients.<sup>[6]</sup>**

- 1) Potassium Nitrate:-Sanskrit name suvarcilavana(shining salt)
- 2) Sulphur
- 3) Charcoal
- 4) Arka and Snuhi

The book Shukraniti explains the procedure of the gunpowder making. These are some applications of powder metallurgy in the field of Ammunition.

## 6. CONCLUSION

Powder metallurgy is an influential branch of metallurgy. The ancient Indian texts contain the knowledge of preparation of the metal powders. But it has not drawn the attention of the technical people because most of the books are related to the Ayurveda and medications. Actually it is a rich heritage of Indian Engineering, and upcoming generations of the engineers need to study and research it. Due to which the modernized version of ancient powder metallurgical practices will be developed, and it can be utilized in the current time. Ecofriendlyness, availability of natural resources are the distinguished characteristics of the above described practices. However the time required for the preparation and complexity in the processes are limitations. The ancient Indians were well aware about the powder metallurgy and its applications in the field of medication and war. It is essential for us to invent the applications of these techniques, which are suitable for today's lifestyle.

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