

Nano Technology in ancient India

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Synopsis: Modern scientists are fascinated with the applications of Nano Technology and are working for new materials and methods. The paper deals with few available references on this technology, available in ancient Indian texts.

Introduction: Particles having one of the three dimensions, less than one tenth or one thousandth of a micron (10^{-7} to 10^{-9} meter) is termed as nano-particle.

Nano particles are mainly used in cosmetics products, Paints and pigments, food items, Rubber industry, sun films for automobiles etc. Modern research scientists found that juice of aloe Vera or leaves of neem trees is useful for the process

But importance of nano-particles was known in ancient India. The available ancient references can be grouped into following categories;

- Ayurveda medicines
- Alchemy
- Stone iconography
- Water divining
- Material Science
- Metallurgy

1-Ayurveda medicines: As per Bhrugu Shilpa Samhita and Shukra Nitee, one of the 64 arts (Kala) is Makarandadikrutee or use of honey for preparation of nano particles. Honey has a property of disintegrating minute particles into nano particles. Many Ayurveda medicines have to be mixed thoroughly with honey so that the human body adsorbs it quickly. Medicines containing gold, silver or copper powders (SwarN, Roupya and Tamra bhasm) are few examples.

It is common practice to add a teaspoon of honey to sugar syrup to stop the crystallization of syrup.

Decoction of Trifala is good medium to prepare nano particles. When dry powder of earth worms (Nag bhasm) is dissolved in the decoction and allowed to rest overnight, a scum containing pure copper particles appears on the surface of the solution.

2-Alchemy: Indian chemistry originated from Alchemy production of artificial gold or silver from mercury or herbs.

Ancient Sanskrit text "Manosollas" by King Someshwar contains a separate chapter (No.4.63, Verses 377 to 392) on alchemy. The translation of the Sanskrit verses is given below.

- With the help of alchemy wealth can be earned. Copper can be converted into gold and Tin can be converted into silver. V377
- Crush completely dried flowers of Palash (flame of forest), mix with milk of she-goat and apply it for three days to complete the process. V378
- Smear the Tin surface with the powder (one-sixth in proportion and the heat it till it becomes beautiful like silver. V379
- Apply a juice of white lotus on Tin for thirty-two day. Heat the smeared Tin or lead and heat it till the black color and smell is removed and it becomes silver like. V380-81
- Smear an oil (of seeds of white lotus) and sulphur seven times to copper surface. Copper is then heated. With such process copper becomes gold and it can be heated and cut for further applications. V382-83
- The oil (mentioned above) can be mixed with vermilion, sulphur or mercury .The decoction can be used for rubbing the metals. The decoction should be applied on tin plates and should be fired again and again for thirty-two days (by wise person). V384-85
- The Tin becomes gold which is soft and can be further used for different purposes. V386
- Filter with fine cloth powdered resin of teak tree also the dry powder of drumstick roots. Coat a copper plate with such powder and heat it for five times so that it becomes gold. V387-88

- Mix the juice of teak tree with Manjisha-(roots of creeper -Rubia cord folia).Apply the mixture on copper and heat it till the copper becomes gold. V389-90
- Crush barks of teak to get juice of it and mix with juice of roots of oleander (Karveer) and apply to copper plate.
- The copper becomes silver by smearing of mixture and becomes workable for other works. V391-92.

The formulations mentioned above may not be economically viable but more research is needed to collaborate .

3-Stone iconography: Many stone temples and deities are world famous. Some temples are included in world heritage structures. The intricate rock or stone carving is amazing. The artisans of ancient India were aware of herbs to detect microscopic defects of rock to be used for iconography. They were also aware of certain herbs and minerals to soften the stone temporarily so as to facilitate intricate carving.

Ancient Indian text 'Shilparatna' of Shrikumar contains some information on crack detection and softening of rocks and the same is presented below.

Apply any one of the herbal paints for softening of stone before intricate carving.

- Mix powder atis root, Hiracus and red ochre in milk. Apply this paint to the stone and keep it overnight.
- Grind Jatamasi, Koshta, Gayatri Hirkus and chor in milk add coconut water. Apply the solution to the stone.
- Grind and mix Jatamasi, Rog and Aswamari in rain water. Apply the solution to the stone. Ref. Shilparatna, Vol.1, chapter 14, Verses 22,34 – 35.

<p>तुल्यांशक्षीरपिष्टैस्तु विसकासीसगैरिकैः। दृषदालिष्य निःशेषमेकरात्रोषितं भवेत्॥१-१४-२२॥ कासीतचोरौगोक्षीरे पिष्टवाचालेपयेत शिला । मांसीकुष्ठगयारात्रिं त्रिफलावारिदांबुभिः ॥१-१४-३४॥</p>
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मासीरोगहवारियादजलैः सार्धपलनांत्रयं ।
पिष्टवामविलोचनास्तनभुवा क्षीरेण तां लेपतेद् ॥१-१४-३५॥
शिल्परत्न भाग १ अ १४

Inca tribes, which are believed to be descendents of Maya stone cutters of south India, use a juice of local plant of Brazil (South America). Tribal people of Melghat were aware of a leaf which can make white betel nut very soft so that toothless old people can chew the nut when wrapped in that leaf.

4-Water divining: Dowsing is a method to locate underground water sources. Dowsing technique includes use of pendulums, Y rods etc, to find metals, ores, gemstones, oils and lost articles.

If during birth of a child, feet appear first, such child is called Breach child. Such person possesses some magnetic powers which are useful for water dowsing.

If such person (born as breach child) is not available, dowsing can be done by any person with the help of herbs mentioned in ancient Indian text Mantrashastra

A herbal paste is prepared by grinding ten types of seeds or roots in cow's urine. Such paste is applied to the feet of a person who wishes to do dowsing. This paste helps in locating underground water.

Ancient Indian text "Mantrashastra" describes the constituents of this herbal paste.

वन्हिकोषातकीवज्री श्वेतार्क गिरिकर्णिका ।
वचापाठाच निर्गुडी कटुतुंब्याश्मूलकं ।
निंबकेशरबीजानि गोमुत्रैः पेषयेत्क्षनैः ।
अनेन पादलेपेन पश्येत भूमिगतं जलं ॥मंत्रशास्त्र

The herbal paste is some form of nano magnetic particles. This technique, mentioned in the ancient Indian text, needs to be verified with a systematic joint research by Botanists and engineers.

5- Material Science: The world famous text ' Arthashastra' by Kautilya contains information about herbal alkalis of various types. It mentions alkalis for softening of materials like animal horns, old leather skin etc. The ingredients like Barley, Walnut tree bark, Palash tree bark, Black gram paste, Banana tree stem, Yeast, Sesame seeds and Yam, honey etc are mentioned.

यवमाषतिलपलाशपीलुक्षारैः गोक्षीराजक्षरैर्वा कदलीवज्रकंदप्रतीवापोमार्दवकरः ।
वृक्षाम्लकरमर्दम्र विदला ,मलक, मातुलंग, कोल, बदर, सौवीरक,
पुरुषकादिः
। कौटिल्य अर्थशास्त्र

Such organic herbal alkalis were used in Ayurveda medicines and alchemy.

6-Metallurgical applications:

Skill 1- Dhatu Aushadhi sanyog - Use of herbs in metal smelting is an ancient Indian art mastered by tribal iron smiths (known as Munda, Karmars or Asura)

They do not know the theory of smelting. But they can convert iron into steel by treating it with dried wood and green leaves (medicine). This medicine , probably contains carbonated hydrogen in very different proportions, such that iron passes into the state of steel quickly and with a smaller bulk with particular kind of vegetable matter that with others. The cassia auriculara is used for this purpose."

A U.S. metallurgist Mushet explains this phenomenon in following words'

"On elevating temperature an abundant evolution of carbonated hydrogen gas would take place from the vegetable matter, and as its escape would be prevented it would be retained in contact with iron , which at a high temperature have a much greater affinity for gaseous than for concrete carbon. This would shorten the operation and probably at a much lower temperature than were the iron in contact with charcoal powder.

From the above quotations it can be understood how Indian black smiths used to melt iron ore and by adding specific leaves and feathers of birds and convert iron into steel. Even nomadic tribes like Mudas had perfected the technique of steel making.

The Iron smelting technique of Munda blacksmiths (Karmar) is briefly mentioned in Rig-Veda (RV 9.112.2).

जरतिभिः औषधीभिः पर्णेभिः शकुनाना कर्मारः
अश्मभिः द्युभिः हिरण्यवंतमिच्छति।ऋग्वेद ९.११२.२

Skill 2- Tempering of steel: For farmers, time to time tempering of steel implements such as plough, sickles, crow bars, pick-axe was essential. Few ancient texts are available on this subject and the procedures mentioned are given below.

A- Viswamitra Dhanurveda mentions that;

1. Grind Pimpali (Piper longum, Linn), Saindhav (Rock salt-salt of Sindh) and Kusta (Saussurea Lappa) in cow's urine (Gomutra)
2. Coat the tiller with this mixture and heat it in a fire till the color of steel turns yellow.
3. Immerse in oil till it cools down.

पिप्पली सैधवी कुष्ठं गोमुत्रेण च पेषयेत् ।
अतिशीतमनाविध्दं पीतं नष्टं तथोषधं ॥
अनेन लेपयेत्फालं लिप्तं चाग्नौ प्रतापयेत् ।
ततो निर्वापितं तैले पायितं तद्विदिशिष्यते ॥
विश्वामित्र धनुर्विद्या

B-Jamadnya Dhanurveda mentions that;

1. Grind five types of salts# (Panchlavan) to fine powder
2. Add mustard (Sasharp) seeds and honey.

3. Coat the tiller with this mixture and heat it in a fire till the color of steel turns blue like neck of a peacock.
4. Immerse in cold water.

शिखिग्रीवानुवर्णाभं तप्तपीतं तथौषधं ।
ततस्तु विमले तोये पाययेत् शस्त्रमुत्तमं ॥ जामदग्न्य धनुर्विद्या

c-Process recommended in Vashishtha Dhanurveda

1. Grind five types of salts# (Panchlavan) to fine powder
2. Add mustard (Sasharp) seeds and honey.
3. Apply the paste to the implement and heat it in a fire till the color of steel turns similar to orange.
4. Immerse in cold water.

पंचभिर्लवणैः पिष्टं मधुसिक्तैः ससर्षपैः ।
एभिः प्रलेपयेत् शस्त्रं लिप्त चाग्नौ प्ररापयेत् ॥ वशिष्ठ धनुर्विद्या

-Five salts are

1. Saindhav (Rock salt-salt of Sind)
2. Sambar or Romaka (Salt from Sambar lake near Ajmer, India)
3. Vid (Artificially prepared salt prepared in dark red granules containing sodium chloride and traces of sodium sulphate, traces of alumina , magnesia, ferric oxide and sulphate of iron)
4. Samudra (Common salt prepared from sea water)
5. Sochar or Sauvarchalal (Dark colored salt made by dissolving common salt in a solution of crude soda and evaporating it)

7-Conclusions: Based on available information it can be concluded that applications of nano technology were known to people in ancient India.

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