FUNDAMENTALS OF POWDER MANUFACTURING

Dr.Alaa Aladdin

CERAMIC MATERIALS TECHNOLOGY

Powder technology is a fundamental engineering field that deals with a variety of particles, from sub-microscale grains and aggregates to multi-phase colloids.

The applications of powders and particles are rapidly expanding into more diverse technologies, from the information market—including mobile phones, copy machines, and electronic displays—to pharmaceuticals, biology, cosmetics, food and agricultural science, chemicals, metallurgy, mining, mechanical engineering, and many other fundamental engineering fields.

Following some of the latest developments, nano-particles are the focus of promising research leading to more effective applications of various particles and powders

HISTORICAL PERSPECTIVE

The first ceramic objects in the history record are fired clay figures appearing about 2000 B.C. . These figures were probably natural clay pieces shaped by hand into a humanoid form, allowed to dry, and placed in a fire. This art form gradually became used for more practical objects such as bowls and storage vessels on a much larger scale. This larger scale of production became an integral part of the Chinese villages about 6000 B.C., where the ceramic furnace played a central role .

Natural Raw Materials

RAW MATERIALS

1- Clays :Kaolinite $Al_2(Si_2O_5)(OH)_4$,Halloysite $Al2(Si2O5)(OH)4.2H2O$

2 -Talc :$Mg3(Si2O5)2(OH)2$

3 -F e l d s p a r: an anhydrous aluminosilicate, $K(AlSi_3)O_8$,$Na(AlSi_3)O_8$, $Ca(Al_2Si_2)O_8$

4- Silica: is both abundant and widespread in the earth's crust. In addition,it is one of the purest of the abundant minerals.

5- Wollastonite: Another source of water insoluble calcium ($CaO .SiO_2$).

used in ultralow ceramic insulating bodies and as an helpful flux in

electrical insulators.

6- Aluminum Minerals: Corundum ($A1_20_3$) ,common abrasive. Sillimanite ($A1_2SiO_5$ for refractory's. Kayanite ($A1_20_3 . SiO_2$) , mullite ($3A1_20_3 . 2SiO_2$) refractory's and porcelain spark plug insulators

7 -Lithium Minerals ($Li_2A1_2Si_40_{12}$)

8-Fluorine Minerals:(CaF_2)

- Transformed Natural Raw Materials

Magnesite ,Calcite Magnesite $CaCO_3$ Barium Minerals:$BaSO_4$, $BaCO_3$ Lead Minerals: (PbS) ,$PbSO_4$

- Synthetic Raw Materials

١. **Alumina $A1_2O_3$.$3H_2O$**
٢. **Chromia Chromite Cr_2FeO_4**
٣. **Magnesia (MgO)**
٤. **Soda Ash, $NaCO_3$**
٥. **Titania TiO_2**
٦. **Zinc Oxide ZnO**
٧. **Zirconia ZrO_2**
٨. **Silicon Carbide**
٩. **Metal Carbides SiC, TaC, TiC, Cr_3C_2, VC, Mo_2C, B_4C, WC, and ZrC.**
١٠. **Metal Nitrides Si_3N_4, AlN, TiN, VN, and BN**
١١. **Borides TiB_2, BC, W_2 B, and MoB**

SELECTING A RAW MATERIAL

To select a ceramic raw material, it is necessary to know the:

1- Final material properties of the ceramic product

2- Ceramic process by which it will be fabricated.

3- Physical property

4- Temperature fabrication,

5- Chemical formulation.

6- Powder mixing

7-Formation.

8-Similar particle morphology and size distributions

9- Particle size shape compatibility.

10- Sometimes surface chemistry compatibility is also important.

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