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Business, Industries

It isundoubted that the modern technology has been improving better and stronger inrecent years, however, people are gradually starting to ignore the impact of littlethings that have contributed plenty to the social economic growth and the humandevelopment at the same time. In term of " little things", one of the species calleddesiccant is significantly noticeable in everyday life but also easily despisedthough due to their size and price. Desiccants are not obviously referred orseen around us but already have been working efficiently in numerous fields foralmost 400 years.

As a matter of fact, desiccants are broadly used by us todayand are playing significant roles in different fields, thus the discovery andadvance of them are worthwhile to explore and develop to a large extent. The desiccant is defined as " a hygroscopicmaterial that serves to maintain a state of dryness1" and most commonly, one of which calledsilica gel (SiO2) (Figure 1) was in existence as early as the 1640sas a scientific curiosity2 and later was used in World War I for the adsorption of vapors and gases in gas mask canisters. Realizing its value, achemistry professor called Walter A. Patrick at JohnsHopkins University has invented certain new and useful improvementsand a synthetic route for producing silica gel in 1918. Other thancarrying out a simple process to yield a uniform product, the new silica gelinvented is in the form of small beads but possesses abundant pores inside itshard shell at the same time, which when the water content is greatly reducedwill be transparent and showing a glassy appearance. To excel the property, thesilica gel is also designed as to remain stable at high temperatures thus being able to work under several conditionsefficiently.

In general, silica gel is prepared in order by mixing solutions ofsodium silicate or water-glass with acid solutions, which prevents any othermixtures forming during the process. After that, the excess acid and the saltformed in the reaction are then removed from the solution, which is always doneby a slow dialysis process. However, the concentrations of acid and water-glasssolution are required to be determined very cautiously as it will give rise toa clear gel within 4 or 5 hours after mixing. Also, to avoid a rapidcoagulation that would take place because of the instability of the mixture, anefficient stirring is needed to the solutions. 3 The special part of the invention is that thephysical adsorption of water vapor into its internal pores and with noby-products forming.

Even when contacted with water vapor, silica gel can stillmaintain its property as a dry product with the unchanged shape. It will adsorbup to one third of its own weight in water vapor. This adsorption efficiency isapproximately 35% greater than typical desiccant clays, making silica gel the betterchoice where weight or efficiency are dominant factors to both manufacturersand customers. 4 Figure 1 Structure of silica gel Assilica gel has been greatly improved in the laboratory and has brought so muchconvenience into daily life, soon the demands of this material by various manufacturesacross the globe start to go up promptly. There are several ways ofmanufacturing silica gel in the plants and still being excelled. For instance, commerciallyin Fuji Silysia Chemical LTD, silicagel is derived from a manufacturing method, sol-gel, a process wheremicro particles or molecules in a solution (sols) agglomerate and undercontrolled conditions eventually link together to form a coherent network (gel)5, to generate this

material. Two raw materials, sodium silicate andmineral acid, are used in a wet process to create a reaction in generatingmonomeric silicic acid. These monomers polymerize to generate primary silicaparticles, referred to as silica sol.

The particles then aggregate to form athree-dimensional structure in a gel state maintaining a low refractive indexof 1. 46. During this process, growth conditions affecting the primary particles(sizes 3-30nm) are controlled to modify physical properties such as surfacearea, pore diameter and pore volume. 6 (Figure 2) And according to another process offered by NationalResearch Development Corporation, clear stable solution of sodium silicateafter proper dilution with deionized water is filtered.

The filtered solutionis then percolated from top through an ion-exchange column. The operation is sosynchronized that when the percolation is going on in one exchange column, regeneration of the other columns is simultaneously carried out. After that, thepercolated silica sol is treated with ammonium hydroxide and dried under sunwhere it becomes gelified. The hardened gel in the trays is then conveyed intoa compartmental tray drier and finally dried to 5 to 10 percent moisturecontent in an electric oven at 120 degrees and packed in air tight plasticcontainers for dispatch. 7 Figure 2 Flow chart of manufacturing silica gel However, there are still potentialrisks that could occur while manufacturing the silica gel, which requires greatattention to be paid. For example, the occupational exposure to airbornecrystalline silica such as during sand blasting, tunneling, or work

in aquarry, does have hazardous health impacts and may cause several respiratorydiseases or even lung cancer.

Inhalation exposure to respirable crystallinesilica can also cause silicosis, which in severe cases can be disabling, oreven fatal. Silicosis may occur when respirable-sized crystalline silica dustis inhaled into lower reaches of the lung and causes the formation of scartissue, thus reducing the person's ability to take in oxygen. 8 Therefore, in order to keep more workers awayfrom these related diseases, in Britain, RCS (Respirable crystalline silica)exposure has set up a workplace exposure limit (WEL), which contains the exposurebelow a set limit, preventing excessive amount.

The WEL for RCS is 0. 1 mg/m3expressed as an 8-hour time-weighted average (TWA). Exposure to RCS is alsosubject to the Control of Substances Hazardous to Health Regulations 2002(COSHH)9. Back to the daily life, the silica gel beadsin snacks which are usually packed in a small pouch are likely to be swallowedoccasionally by children. Although it is not a big problem doing that as thematerial is non-toxic and chemically unreactive, the improvement still needs tobe considered as the beads may cause suffocation and some of the silica gel isdoped with a moisture indicator while manufacturing which is carcinogenic tohuman's body.

That is the reason why every packet is still printed with strongwords of caution, DO NOT EAT. It is possible to apply appropriate amounts ofbitter flavorings onto the beads to prevent children tasting. Alternatively, the form of silica gel couldbe changed from solid to gas and then filled in the little pouch like hownitrogen gas works to snacks. Not only being extensively

manufacturedin a variety of commercial, industrial, and household applications, the silicagel is also widely used in water filtration, or as a food additive, which hasbrought about massive profit to the manufactures. Owing to its simplemanufacturing process, high specific surface area and outstanding adsorptioncharacteristics, silica gel is considered as one of the cheapest desiccants aroundthe world, which enhances the demand in the use of silica gel significantly fromthe APAC region (excluding China) and becomes one of the major manufacturing trendsin the market in recent years. According to the report, the increased demandfor silica gel in China, resulting from theincrease in economic and industrial development in the country these years, isthe major factor for the growth of the market and is also highly expected tobenefit the entire Global Silica Gel market in the future.

10 To enhance the profit from manufacturingsilica gel and realize the plan as soon as possible, it is feasible tonormalize the product manufactured in the plants in their characteristics, sizes and outputs thus cuts down the costings. Today, Silica gel is commonlyclassified as one of the most frequently-used desiccant but still beingimproved in its characteristics and manufacturing costs. That is only one of the species of the desiccantsthat can physically absorb water molecules from the humid air, caused bythousands of microscopic cavities that create a lower vapor pressure inside it.

It is strongly believed that the other desiccants are also feasible to be fullyused by triggering various chemical reactions. Ideally, excess water is able bereacted or transferred into other forms or products such as steam

and heat, andtherefore, apart from obtaining a dry situation, the new products generated arevery helpful in other efficient use at the same time. The process of desiccants, from being researched in the laboratory to a bulk chemical manufacturing plant, not only shows us the improving of discoveries, but also implies a persistentspirit that encourages people to learn from. 1 DeltaAdsorbents, " What is a desiccant", 2013. https://www. deltaadsorbents. com › Blog 2 MaryannFeldman and Pierre Desrochers (March 2003). " Research Universities and Local Economic Development: Lessonsfrom the History of the Johns Hopkins University".

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