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Color indicators Which color indicators are used?

Many silica gels are provided by the manufacturer with a low level of moisture indicators. They indicate a loading condition based on a color change. The moisture indicators for silica gels are divided into two types:

- pH-Indicators
- Metal salts

The pH indicators work on the principle of neutralization. When dry, the indicator is surrounded by an acidic or alkaline environment. The milieu is generated by the indicator or an additionally applied acid or base. The entry of water sets the environment to a neutral pH. This change in pH results in a color change of the moisture indicator. The pH in the dry state is crucial for the amount of water needed to cause a color change. A well-known example is the crystal violet.¹



Figure: Silica gel with the moisture indicator crystal violet (right with and left without water).²

¹ Lohrengel, Burkhard (2007): Introduction to thermal separation processes, Oldenbourg Verlag München Wien.

² CALDIC Germany, Safety Data Sheet Caldicgel Oranje B, Caldic Germany GmbH, s.a., Dusseldorf.



Moisture indicators from metal salts cause the color change due to the formation of complexes. Complexes arise as a result of the incorporation of water of crystallization³ or a reaction of the metal salts with water and chloride ions.⁴ An example of the incorporation of water of crystallization is the cobalt dichloride, see figure. The silica gel Blue Pink has a moisture indicator of cobalt dichloride.⁵



Figure: Silica gel with the moisture indicator cobalt dichloride (left without and right with water).

The metal salts form a complex with chloride ions. Depending on the water concentration, the complex is formed with water or chloride ions.

⁶ At high humidity, the complexes form with water, which have a different color than the complexes with chloride ions. A commonly used metal salt is copper sulfate. It is contained in the silica gel orange green.⁷ In the moisture indicator of the silica gel Orange Green is probably a salt containing chloride ions.

The concern of the silica gels depends on the moisture indicators. Pure silica gel is not harmful to health. The moisture indicators of the silica gels used by Giebel FilTec GmbH are all metal salts. The most harmful to health is the silica gel Blue Rosa, with a moisture indicator of cobalt dichloride. The REACH Regulation classifies it as of particular concern because it is carcinogenic and toxic for reproduction. Copper sulphate, which is contained in the silica gel orange green, poses a health-threatening risk if ingested. It causes skin irritation and eye disorders if touched. During disposal, the harmfulness to aquatic organisms must be taken into account. Silica Gel Orange Colorless causes skin irritation and eye damage due to ammonium ferric sulfate.

However, the content of copper sulphate and ammonium ferric sulphate in the silica gels is so low that no risk arises and it does not have to be stated in the safety data sheet.⁸

³ Gattiglia, M., Moisture Indicators for the Absorbency of a Desiccant, Levosil S.P.A., Laid-Open Patent DE60018939T2 12.01.2006.

⁴ Crystal waters are called water molecules, which are bound in complexes.

⁵ Wisepac Active Packaging Components Co., Ltd., Technical Data Sheet – Blue Indicating Silica Gel Desiccant, s.l., Wisepac Co., Ltd., 2015.

⁶ Gattiglia, M., Moisture Indicators for the Absorbency of a Desiccant, Levosil S.P.A., Laid-Open Patent DE60018939T2 12.01.2006.

⁷ Wisepac Active Packaging Components Co., Ltd., Technical Data Sheet – Orange Indicating Silica Gel Desiccant, s.l., Wisepac Co., Ltd., 2015.

⁸ Wisepac Active Packaging Components Co., Ltd., Technical Data Sheet – Type C Silica Gel, s.l., Wisepac Co., Ltd., 2015.