 

# Gelatine—A Material for Ink Jet Coatings

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## Abstract

Gelatine and its derivatives were described as a component for Ink Jet layers. The absorption of solvent was reconstructed using water and water/triethyleneglycol (TEG) mixtures and unsupported films of gelatines as a model system. The kinetics of the swelling process of gelatine was described as a function of different gelatine types and pH.

## Introduction

Gelatine is derived from connective tissues of different raw materials (pig skin, bones, and hide splits) and is processed in two ways[1]. Consequently a variety of different types of gelatine are available in the market divided into acid processed Type A and alkaline processed Type B.

The swelling of gelatine in water is an important process for this application as ink receiving layer and will be described in this paper with respect to different types of gelatines and conditions especially time, temperature, and pH.

## Results and Discussion

Temperature and pH value have a strong influence in swelling properties of polyfunctional proteins like gelatine. To eliminate the influence of temperature for the comparison of swelling properties we measured the absorption of water (buffer solution) at (20°C at four different pH values as a function of time using unsupported films of different types of gelatines. Gelatines used are listed in Table 1.

Swelling kinetics from these data were described empirically according to an equation used by Robinson.[2,3] The uptake of water per mass of dry conditioned gelatin film *m* (g solution/ g gelatin) as a function of time *t* follows a simple linear equation:

$$t / \Delta m = A + B * t. \qquad (1)$$

*A* and *B* are constants and the reciprocal of *A* correlates to the initial absorption of water at $t \rightarrow 0$ whereas the reciprocal of *B* describes the equilibrium swelling at $t\infty$.

Results of the calculation of *1/A* and *1/B* (plotting $t/\Delta m$ versus *t* and calculate the slope for B and the cross point of the ordinate for *A* according to equation 1 of type A, type B, and chemically modified gelatines are listed in Table 2.

The unit 1/min of 1/A has the dimension of a speed. The reciprocal of B has no unit and represents the factor of absorption of solvent per mass of gelatine film.

**Table 1. Physical data of gelatines used to measure swelling of films thereof(IIP: isoionic point, bloom: gel strength, A: acid processed, B alkaline processed, succ.: succinylated, phthal.: phthalylated).**

| No. of gelatine | raw material | type of process | bloom g | viscosity mPa*s | IIP |
|---|---|---|---|---|---|
| 1 | bone | B, succ. | 208 | 4.15 | 4.3 |
| 2 | bone | B, phtha. | 220 | 5.34 | 4.4 |
| 6 | pig skin | A, succ. | 204 | 3.98 | 4.5 |
| 5 | bone | B | 261 | 5.50 | 5.1 |
| 7 | hide split | B | 240 | 5.62 | 5.1 |
| 8 | bone | A | 296 | 3.69 | 6.5 |
| 9 | pig skin | A | 291 | 3.93 | 9.0 |
| 10 | pig skin | A | 247 | 4.51 | 9.0 |
| 13 | pig skin | A | 275 | 5.57 | 9.1 |
| 11 | pig skin | A | 267 | 6.74 | 9.0 |

Comparing the initial absorption of water (1/A) and the swelling capacity (1/B) of different types of gelatine at different pH values we can deduce from the data in Table 2 that there is often a direct correlation between swelling speed and swelling capacity. Sometimes especially at low pH-value for type A gelatines we detect highest swelling capacity but average initial absorption of water (see No.9, 10, 11, 13 in Table 2).Chemically modified gelatines were recommended[4] for ink jet coatings. They often show a better swelling capacities than type A or type B gelatines. We also proved that speed of water absorption is higher for films of some chemically modified gelatines in the pH levels (see Table 2, No. 2).

Inks for Ink Jet printers often consist of solvent mixtures. We determined the swelling behaviour of gelatine films as a function of composition by using water/TEG mixtures (see Figure 1).

TEG is not as good a solvent for gelatine as water, therefore we see a reduction of the swelling capacity and the initial absorption of solvent which is indirectly proportional to the content of TEG in water.

 

**Table 2. Constants of *1/A* (a) and *1/B* (b)from different gelatines at different pH values.**

**(a)**

| No. of gelatine | constants *1/A* 1/min | | | |
|---|---|---|---|---|
| | pH 3 | pH 5.3 | pH 7 | pH 9 |
| 1 | 0.45 | 0.917 | 0.903 | 0.98 |
| 2 | 0.515 | 1.19 | 1.105 | 1.479 |
| 6 | 0.447 | 0.744 | 0.935 | 0.759 |
| 5 | 0.719 | 0.869 | 0.997 | 1.067 |
| 7 | 0.58 | 0.779 | 0.744 | 0.878 |
| 8 | 0.486 | 0.539 | 0.552 | 0.659 |
| 9 | 0.757 | 0.82 | 0.891 | 0.899 |
| 10 | 0.755 | 0.678 | 0.668 | 0.719 |
| 13 | 0.788 | 0.751 | 0.817 | 0.781 |
| 11 | 0.957 | 0.977 | 0.976 | 0.939 |

**(b)**

| No. of gelatine | constants *1/B* | | | |
|---|---|---|---|---|
| | pH 3 | pH 5.3 | pH 7 | pH 9 |
| 1 | 6.97 | 12.09 | 15.24 | 17.02 |
| 2 | 5.44 | 10.00 | 11.51 | 14.07 |
| 6 | 10.11 | 11.84 | 12.66 | 15.85 |
| 5 | 13.05 | 6.89 | 8.44 | 9.07 |
| 7 | 15.24 | 7.06 | 8.98 | 9.25 |
| 8 | 14.58 | 6.11 | 6.72 | 8.29 |
| 9 | 13.00 | 7.44 | 6.76 | 6.17 |
| 10 | 12.52 | 6.42 | 6.24 | 6.22 |
| 13 | 11.90 | 6.51 | 6.25 | 6.30 |
| 11 | 11.98 | 6.29 | 6.51 | 6.08 |

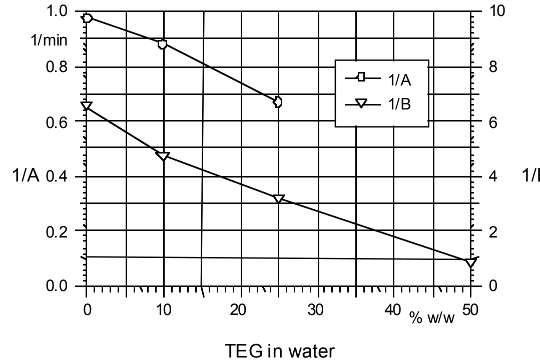


*Figure 1. 1/A and 1/B values of gelatine films swollen in different mixtures of TEG in water (pH 7, gelatine No. 11)*

Primary results indicate that some chemically modified gelatines show a better initial absorption of solvent mixtures than for water, which could improve drying time for ink jet layers containing gelatine.

## References


1. Gelatin, Gelatin Manufacturers Institute of America, Inc., New York, 1993.
2. Robinson, I. D. *Photogr. Sci. Eng.*, 1964, **8**, p 220-224.
3. Ofner, C. M. and Schott, Hans *Journal of Pharmaceutical Sciences*, Vol. **75**, No. 8, August 1986, pp 790.
4. U. S. Patent No. 4. 946. 741 (1990).