Latex and paper

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21.1 INTRODUCTION

In outline, the paper-making process involves the formation of an aqueous slurry of cellulose fibres which are usually derived from wood, and the subsequent formation of a thin layer of dry fibres by filtration against a suitable screen. Wood is reduced to a pulp by a beating process in the presence of water. In this process, the cellulose fibres are subjected to cutting and bruising by blunt blades. The length and degree of fibrillation of the resultant fibres is determined by the intensity and duration of the beating process. Chemical agencies may be used to assist the disintegration process. The pulp is then cleaned and diluted to form the paper stock, from which the paper itself is formed. The paper is formed by filtration of the stock, either against a horizontal screen, as in the so-called fourdrinier machine, or against a cylindrical screen, as in the so-called cylinder machine. In either case, the web of fibres is continuously removed for further processing, the final stage of which may be the application of a suitable coating to the paper to improve appearance and printability.

Polymer latices find application in paper technology principally in three distinct types of process:

1. **beater addition**, also known as **wet-end addition**, in which relatively large amounts of polymer (up to 30% m/m on the dry mass of the finished paper) are added as latices at the beater stage, when the cellulose fibres are still in the form of an aqueous slurry, and before deposition has taken place;

2. **saturation of dried paper**, in which, again, relatively large amounts of polymer (up to 30% m/m on the dry mass of the finished paper) are introduced into the fibre structure, this time by impregnating the dried paper with a latex;

3. **surface coating of paper**, in which relatively small amounts of polymer (usually less than 5% m/m on the dry mass of the finished paper) in latex form are used as a partial or complete replacement for hydrocolloids such
as casein, starch and polyvinyl alcohol as binders for pigments and mineral fillers in paper-coating compositions.

In a fourth type of process, which is really a variant of (2), the paper is saturated with a latex after deposition but before drying has taken place. As far as is known, this type of process is little practised, and is not considered further.

It is difficult to assess the relative importances of these three applications of latices in paper technology. Paper-coating using latex-containing compositions is certainly very widely practised throughout the world. It is understood that beater addition and paper saturation are also widely practised in North America, but the situation in Europe and elsewhere is not so clear. The advantages which accrue from the use of latices in these three ways are considered separately in what follows. It is sufficient to note here that the surface coating of paper differs fundamentally from beater addition and paper saturation, in that only the appearance and other surface properties of the paper are modified by surface coating, whereas beater addition and paper saturation treatments can result in profound changes in the bulk properties of the paper. As noted in section 19.3.4.1 of Chapter 19, processes in which the bulk properties of paper are modified by treatment with a polymer in latex form are similar in principle to those in which a non-woven fabric is formed by treating a web of textile fibres with a latex to bond the fibres.

There appear to be few publications which deal exclusively with the applications of latices in paper technology. A useful introduction is available in a chapter by Charlton, Bowden and Smith [1]. A more comprehensive treatment is available in the book on synthetic resin latices by Warson [2]. An anonymous article which appeared under the editorship of Delafield [3] in 1967 provides a useful summary of the use of synthetic latices in paper-coating applications. Some information concerning the application of natural rubber latex to paper is available in a booklet by Blow [4] which deals mainly with the application of natural rubber latex to textiles. Formulations for paper-impregnation compositions based upon various rubber latices are given in the latest edition of The Vanderbilt Latex Handbook [5].

21.2 BEATER OR WET-END ADDITION OF LATICES TO PAPER PULP

21.2.1 Outline of procedures for beater or wet-end addition of latices to paper pulp

A latex may be added to the paper stock at any convenient point during the preparation of the stock, provided that there is sufficient agitation to cause rapid and uniform distribution of the latex particles within the cellulose fibres. The intention is that the latex particles should become deposited on the cellulose fibres, thereby replacing some of the direct fibre–fibre bonds which would otherwise form subsequently in the paper sheet by fibre–polymer–fibre