produce a stronger pulp. The popular name for this was the "kraft process," from the German word for strong. The kraft process has become the dominant pulping method in paper manufacture. It is faster than other processes and is also practical with a wide range of wood species, though it yields a very dark-colored pulp. Not until the 1930s was an effective bleaching process found to turn kraft pulp into white paper. Other paper bleaching methods had used chlorine since its discovery in 1774. Calcium and sodium hypochlorites were also used for bleaching paper stock after 1800.

Softwood pulp fibers are 0.12 to 0.2 inches long, while hardwood fibers are only 0.04 inches. Fiber diameters vary between 0.0008 to 0.0012 inch. The longer softwood fibers give the paper strength and tear resistance, while the shorter hardwood fibers increase the smoothness and opacity of the sheet. The strength and durability of the finished paper is determined by the fibers and the formation and structure of the sheet. Natural cellulose fibers show no decrease in strength when they are wet, although the paper assembly may lose strength as the fibers float apart.

Paper is distinguished by several hundred different grades according to differences in material properties, raw materials, or manufacturing processes. The "basis weight" of paper, or weight per unit area, is measured in reams (commonly 500 sheets). A ream of "16 pound paper" weighs 16 pounds for standard 8 1/2 x 11 inch paper. Paper is also measured by its thickness and density, and it is segregated according to gloss, opacity, brightness, and color.

The material properties of paper can be improved for specific uses. Since paper composed only of cellulosic fibers is water absorbent, water-based inks penetrate and spread across it, making printing and calligraphy difficult. Early paper makers learned how to impregnate the paper with various substances to hinder wetting; this process is called "sizing." The Chinese used starch for sizing as early as 768. By about 1337, other manufacturers used animal glues and gelatins and vegetable gums. In 1807, Moritz Friedrich Illig published his discovery in Germany that paper could be sized in vats with rosin and alum, though it took another 25 years before anyone put the method to practical use.

In the 19th century, papers began to be coated to provide special surfaces for fine printing. A mixture of white clay, casein or other adhesive, and dyes (if desired) was spread on the surface to fill the small irregularities caused by non-uniform fiber size or uneven distribution across the mesh screen. The smooth surface was ideal for halftone and color printing. By 1875 high-quality machine-coated papers were used to reproduce halftone illustrations through a new photoengraving process. Coatings also improve the gloss and opacity of papers.

Diverse specialty papers are made for continually broadening applications. These papers differ through chemical additives and coatings. For instance, polyethylene-coated paper remains flexible from -65 to 200°F and it also resists creasing; this makes it ideal for packaging applications (bags, boxes, and package liners), as well as for disposable diapers, bibs, and bed sheets. Papers with a high content of rag fibers are extremely durable and therefore are used for bank notes and security notes, filter paper, tracing paper, and extremely lightweight special papers for printing Bibles and rolling cigarettes.

Growing more sophisticated as our communication needs have changed, the production of paper and writing materials has literally spanned the history of human civilization, going from cave paintings and indentations marked in clay tablets to processed plant materials such as bark cloth and papyrus, on to actual paper made from cellulose fibers, and to extremely durable polymer materials. But, with revolutionary advances in information storage technology, magnetic recording media and optical media, the next advance may be to eliminate paper entirely.

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