RADIATION-CURABLE OPTICAL GLASS FIBER COATING COMPOSITIONS, COATED OPTICAL GLASS FIBERS, AND OPTICAL GLASS FIBER ASSEMBLIES

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation application of U.S. patent application Ser. No. 09/035,771, filed on Mar. 6, 1998, which is itself a continuation-in-part application of U.S. patent application Ser. No. 08/877,585, filed on Jun. 17, 1997 (abandoned), which is itself a continuation-in-part application of U.S. patent application Ser. No. 08/840,893 (abandoned), filed on Apr. 17, 1997, which is itself a continuation-in-part application of U.S. patent application Ser. No. 08/745,790 (abandoned), filed on Nov. 8, 1996, all of which are hereby incorporated in their entirety by reference

FIELD OF THE INVENTION

The invention relates to radiation-curable inner and outer primary optical glass fiber coating compositions. The invention also relates to coated optical glass fibers and optical glass fiber assemblies. More particularly, the invention relates to a ribbon assembly having improved ribbon stripping capabilities.

BACKGROUND OF THE INVENTION

Optical glass fibers are usually coated with two superposed radiation-cured coatings, which together form a primary coating. The coating which contacts the glass surface is called the inner primary coating and the overlaying coating is called the outer primary coating.

The inner primary coating is usually a soft coating having a low glass transition temperature (hereinafter "Tg"), to provide resistance to microbending. Microbending can lead to attenuation of the signal transmission capability of the coated optical glass fiber and is therefore undesirable. The outer primary coating is typically a harder coating providing desired resistance to handling forces, such as those encountered when the coated fiber is cabled.

For the purpose of multi-channel transmission, optical glass fiber assemblies containing a plurality of coated optical fibers have been used. Examples of optical glass fiber assemblies include ribbon assemblies and cables. A typical optical glass fiber assembly is made of a plurality of coated optical glass fibers which are bonded together in a matrix material. For example, the matrix material can encase the optical glass fibers, or the matrix material can edge-bond the optical glass fibers together.

Optical glass fiber assemblies provide a modular design which simplifies the construction, installation and maintenance of optical glass fibers by eliminating the need to handle individual optical glass fibers.

Coated optical glass fibers for use in optical glass fiber assemblies are usually coated with an outer colored layer, called an ink coating, or alternatively a colorant is added to the outer primary coating to facilitate identification of the individual coated optical glass fibers. Such ink coatings and colored outer primary coatings are well known in the art. Thus, the matrix material which binds the coated optical glass fibers together contacts the outer ink layer if present, or the colored outer primary coating.

When a single optical glass fiber of the assembly is to be fusion connected with another optical glass fiber, or with a connector, an end part of the matrix layer can be removed to separate each of the optical glass fibers.

Desirably, the primary coatings on the coated optical glass fibers, and the ink coating if present, are removed simultaneously with the matrix material to provide bare portions on the surface of the optical glass fibers (hereinafter referred to as "ribbon stripping"). In ribbon stripping, the matrix material, primary coatings, and ink coating, are desirably removed as a cohesive unit to provide a clean, bare optical glass fiber which is substantially free of residue. This residue can interfere with the optical glass fiber ribbon mass fusion splicing operation, and therefore usually must be removed by wiping prior to splicing. However, the step of removing the residue can cause abrasion sites on the bare optical glass fiber, thus compromising the strength of the connection. The superior stripping functionality of ribbon assemblies to provide clean, residue-free, bare optical glass fibers during ribbon stripping according to this invention has heretofore been believed to be unobtainable.

A common method for practicing ribbon stripping at a terminus of the ribbon assembly is to use a heated stripping tool. Such a tool consists of two plates provided with heating means for heating the plates to about 90 to about 120 C. An end section of the ribbon assembly is pinched between the two heated plates and the heat of the tool softens the matrix material and the primary coatings on the individual optical glass fiber. The heat-softened matrix material and heat-softened primary coatings present on the individual optical glass fibers can then be removed to provide bare optical glass fiber ends, at which the fusion connections can be made. A knife cut is often used to initiate a break in the matrix material to the inner primary coating. Typically, only about a 1 to 4 cm section of the matrix material and coatings on the optical glass fibers need be removed. Identification of the bare individual optical glass fibers achieved by tracing back along the bare optical fiber until the ink coating or colored outer primary coating is seen.

U.S. Pat. No. 5,373,578 discloses a ribbon assembly containing a plurality of coated optical glass fibers. Each of the optical glass fibers is coated with an inner primary coating which is adjacent to the optical glass fiber, with an outer primary coating and an ink coating on the outer primary coating. The inner primary coating is modified so that adhesion between the inner primary coating and the optical glass fiber is reduced. This reduction in adhesion facilitates easy removal of the heat-softened primary coating when using a heat stripping method. While this patent discloses, at column 5, lines 10–13, that the adhesion between the inner primary coating and the optical glass fiber should be sufficient to prevent delamination of the inner primary coating from the optical glass fiber, any reduction in the adhesion between the inner primary coating and the optical glass fiber increases the possibility of such undesirable delamination, especially in the presence of moisture. Delamination of the inner primary coating from the optical glass fiber can lead to degraded strength of the optical glass fiber as well as signal transmission attenuation disadvantages.

Published European patent application 0262340 discloses a ribbon cable having a "peel layer" as the outermost coating layer on each of optical glass fibers contained within the ribbon cable. During ribbon stripping, the peel layer is destroyed and the matrix material is removed from the coated optical glass fibers. However, after ribbon stripping, the optical glass fibers are still coated with the primary coatings. That is, the primary coatings are not simultaneously removed with the matrix material in the ribbon assemblies disclosed in this publication.