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Environmental Material Management for Outdoor Telecommunication Network Systems

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Abstract

The environmental material management of access telecommunications network systems in NTT regional companies is introduced. Copper cables are the main target to be addressed. Metals in copper cables have been effectively recycled. However, polymers have been partly incinerated or disposed in industrial dumping sites, despite their relatively large contents in the copper cable. The NTT corporate group established the first closed-loop recycle system for the polyethylene cable sheath, a major polymer constituent, in commercial basis. Since the whole recycle scheme including waste collection and transportation is efficiently fabricated, it is also economically sustainable. Recycles for other polymer-based components are also introduced. Telephone poles are other important plants, and waste concrete poles have been recycled, where even crushed concrete pieces are used for an underlying layer of road. Waste steel telephone poles themselves can change into a good scrap material for recycle. We are additionally considering the extension of their life time by employing a poly(ethylene terepthalate) powder coating. This strong and durable coating prevents the underground part of the telephone pole, exposed to corrosive environments, from corroding for a long time, hence greatly prolonging its life time. In addition, removed steel telephone poles from the field can be reused, where only visual inspection for corrosion or damage is required.

Key words: reduction, reuse, recycle, copper cable, telephone pole

1. INTRODUCTION

Plants and equipment for outdoor network systems of regional telecommunication carriers, such as NTT-East and NTT-West, occupy the major portion of their properties both in terms of volume/weight and economic value. At the same time, environmental concerns have been mounting, and dwindling dumping sites of industrial wastes are an imminent issue to be solved [1]. Therefore, the proper waste management and efficient use of materials for the access telecommunications network systems are essential.

Various projects for environmental materials management being operated in the NTT corporate group are introduced in this article. Cables and their related structures are the major targets, large amounts of which are removed and replaced in the fields every year. First, the closed-loop polymer recycle for copper communication cable sheaths is described. Other recycle examples for outdoor polymer components are also mentioned. Telephone poles are made of steel-reinforced concrete or steel cylinder, and materials used for them are basically recycled. We have further considered the reduction and reuse of steel telephone poles in addition to their recycle. The strategy and approach to accomplish these objectives are explained in detail.

2. POLYMER MATERIAL RECYCLES FOR CABLES AND OUTDOOR NETWORK COMPONENTS

2.1 Closed-loop material recycle for polyethylene sheath of copper telecommunication cables

Most parts of copper telecommunication cables have been effectively recycled. Fig. 1 shows the schematic diagram for the current recycle or material management system of waste copper cables. Since copper wires have high economic value, recycling companies are willing to accept the cable wastes and the removed copper, which is a good raw material itself, are sent to the refinery. Other metal components like steel tension member and aluminum sheet have been subjected to material recycle processes as well. However, polymers used for copper cables can be incinerated and/or disposed in industrial dumping sites.

In order to further improve the recycling rate, we focused on the polyethylene (PE) cable sheath, which constitutes an innegligible portion of cables, especially in terms of volume. Thus, the first closed loop recycle

system for PE cable sheath was established, and has been operated since the beginning of fiscal 2002. Basically, collected waste cables go through the same sub-processes as the current ones until removing PE sheath (Fig. 1, 2). Thus prepared PE precursor is washed and shredded into small pieces, and they then undergo melt-extrusion to form recycled PE pellets (Fig. 2). These pellets are mixed with new ones, and then used for the raw material to produce a recycled PE sheath.

The whole recycling scheme including planning, scheduling and transportations is very efficiently constructed in corporations with cable manufactures and waste-processing companies. Each cable factory works as a hub for the closed-loop circulation. Typically, waste cables, irrespective of their original manufactures, are gathered to the particular regional waste-processing site that is affiliated with the hub factory located in the region. This has significantly reduced the cost, and makes the recycled cables both environmentally and economically sustainable.

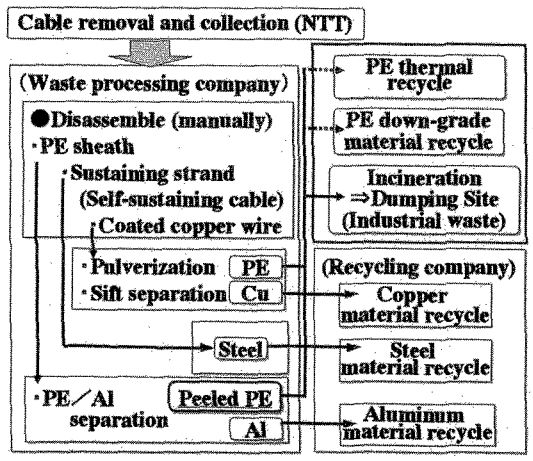

Fig.1 Current material management system for waste copper telecommunication cables.

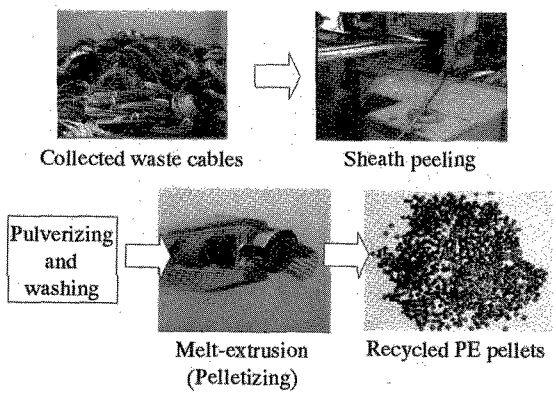

Fig.2 Material recycle process for PE cable sheath

2.2 Other material recycles for polymer outdoor components

Examples of recycled polymer products, which are made from parts of NTT plants or products, are shown in Fig. 3. The protective guard for stretching strand has a laminate structure of a yellow PE over-layer and a black PE under-layer. The latter is also made in a closed-recycle loop. The black color of the under-layer does not require color control, which makes the material recycle easier. The manufacturing process for the recycled protective guard is similar to that for the cable sheath, where recycled PE pellets are first produced and then melt-molded to form the laminate structure. The warning cover sheet for telephone pole, whose reflective yellow strips give a warning sign to automobile drivers, is a similar recycled product. The black base sheet is made of the recycled PE from aerial cable terminal closure, and reflective stripes are laminated on the base sheet.

The drop wire hanger is another interesting recycled product. This is made from the waste poly(vinyl chloride) of old analogue telephone bodies, which had been produced until 1970s and have been leased to customers.

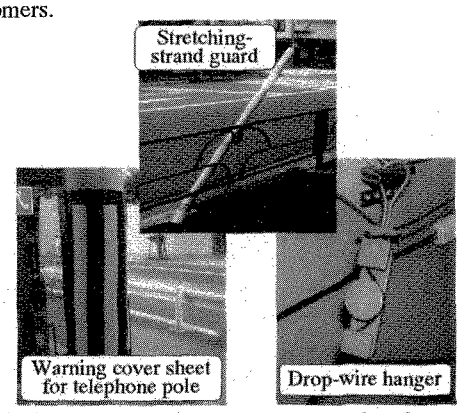

Fig. 3 Access network components made of recycled polymers.

3. ENVIRONMENTAL 3R'S MANAGEMENTS OF TELEPHONE POLES

3.1 Concrete telephone poles

Concrete telephone pole consists of hollow cylinder of steel-bar reinforced concrete. Waste concrete telephone poles are crushed, and steel bars are then removed. The steel bars by themselves become a good scrap material, which is finally sent to a steel mill for recycle. The crushed concrete debris is mainly used in civil constructions like building roads.

3.2 Steel telephone pole with PET powder coating

Steel telephone pole has a hollow cylindrical structure, too. Steel itself is a good scrap material as stated before. Therefore, this is already recyclable. We tried to further reduce its life-cycle environmental impact. We focused on the over-coating done in the lower part of telephone pole, and improved its performance and durability. This coating prevents the corrosion in harsh underground environments where both water and salts, corrosion promoting factors, exist. Although zinc is coated on the steel surface as an anti-corrosion film, which works as a sacrifice electrode against corrosion, the corrosion prevention capability is significantly reduced in a wet environment.

We have employed a poly(ethylene terephthalate) (PET) powder coating for enhancing the protection capability of coating. This coating process is schematically shown in Fig. 4. PET powder is deposited on a zinc-coated steel surface heated above the melting point, and melted to form a thick film [2, 3]. The film is next quenched to become tough, and sticks to the zinc

surface very well. This film is pinhole-free and withstands severe outdoor environments for a long time, tens of years. Furthermore, recycled PET powder, like that made from PET bottles, can be used as a raw material, and no organic solvent is involved in this coating process.

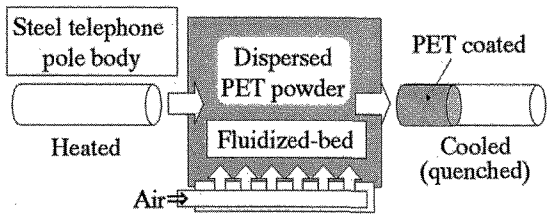

Fig.4 Process for PET powder coating.

The strong and durable PET coating withstands the scratch and collision while a telephone pole is built, and thus treated steel telephone poles have a substantially longer life-time. This reduces the frequency of their exchanges or replacements, and hence the total material input is decreased. It is both environmentally and economically advantageous due to the reduction in natural resource/energy/labor necessary for the production and waste treatment. This also reduces the labor cost and energy for exchanging degraded telephone poles. In addition, the integrity or degradation of telephone poles can be easily assessed by inspecting the coating surface. Without visible corrosion, telephone pole maintains an initial mechanical strength, and this simple checking method leads to a significant reduction in maintenance cost. Furthermore, used telephone poles that are removed from the field for other reasons than degradation can be reused after the inspection. All these further contribute to the reduction in environmental impact.

The recycle and reuse flow for removed steel telephone poles is shown in Fig. 5. After the inspection, they can be reused as stated earlier.

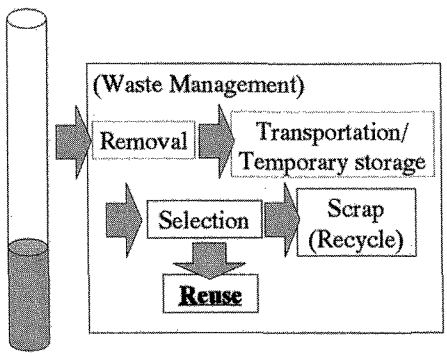

Fig.5 Waste management scheme for steel telephone poles with PET powder coating.

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