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# Brief Introduction of the Cabling Technology with Air-blown Micro Ducts and Micro Cables

Lu xingxing, Ruan Yunfang, Yang Qiao, He Jun, Liu Peidong, Xiong Zhuang

Abstract: As a new type of cabling technology which has been applied in China in recent years, the cabling with air-blown micro ducts and micro cables is being adopted by more and more communication operators depending on its many advantages. In this paper, the cabling technology with air-blown micro ducts and micro cables is introduced from the following aspects: the application status of cabling with air-blown micro ducts and micro cables at home and abroad, the comprehensive comparison between optical fibre cabling system and the cabling technology with air-blown micro ducts and micro cables, and the common products for the cabling with air-blown micro ducts and micro cables.

Key words: Air-blown, micro ducts, micro cables, cabling

## 1 Introduction

With the development of global communication service, telecom operators are faced with two major problems: 1. Although the investment is limited, optical cable routing should still be built to meet the increasing needs of users. 2. They must try to find ways to reduce the cost of infrastructure for optical cable routing as well as the cost of purchasing optical cable lines.

The technology of cabling with air-blown micro ducts and micro cables solves these problems very well. In this kind of cabling, the protection duct will be laid in advance, the micro duct will be blown into the protection duct with compressed air as needed at any time, and then the micro optical fibre will be blown into the micro duct, or the optical cables will be laid through air blowing directly.

The technology of cabling with air-blown micro ducts and micro cables has many advantages. It can use micro ducts and micro cables to improve the optical fibre assembly density and save duct resources. In the initial stage, only the optical cables with proper capacity need to be laid; later, the optical cables can be blown into the micro ducts of the built-up protection duct in batches according to the development demand by stages, so that the initial input will be saved and the problem that a large number of optical fibres are unused will be avoided. The optical cable bifurcation can be increased at any time according to the service needs, and Y-type connector can be used to reduce the connectors of the optical cables, which is beneficial to improve the transmission performance of optical fibre. The construction will be less disturbed by the external climate and the inside conditions of the duct manhole; since the air blowing speed is fast and the distance of air blowing at a time is long, the construction period will be greatly shortened. This technology is also convenient for the adding of new varieties of optical fibres in the future and conductive to keeping the position of leading technology and constantly adapting to market needs.

## 2 Application Status of Cabling with Air-blown Micro Ducts and Micro Cables at Home and Abroad

The technology of cabling with air-blown micro ducts and micro cables has been put into practical use

in Europe and America since 2000. In 2011, the sales amount of air-blown micro cables accounted for about 30% of the sales amount of optical cables in France and the developed countries in southern Europe and America. In 1997, the telecom company NKF of the Netherlands put the micro ducts and micro cables technology into commercial use for the first time by using the air-blowing technology and equipment of Plumettaz S.A. (Switzerland). In 2002, a more than 600 km micro-cable communication line was opened between San Diego and Phoenix in the United States, which marks the formal application of micro ducts and micro cables technology in long-distance trunk line. This project is about 650 km long, and the design scale of the final optical cable is 288 cores (five 60-core optical cables). The construction will be carried out in five phases, with only one 60-core optical cable and five optical cable micro ducts blown in the initial phase. The remaining optical cables will continue to be blown into the spare optical cable micro ducts according to the business needs in the future. The construction is planned to be carried out in four phases in the next 10 years. This could not only meet the current optical fibre needs, but also save the initial investment cost, and was welcomed by the operating company. After ten years of development, this technology has been successfully applied in long-distance trunk lines, metropolitan area networks and access networks in Europe and America.

Under the influence of the international environment, the overall construction of FTTX has also been started in China, and the "11th Five-Year Plan" also explicitly mentions the need to build and develop the "Integration of Three Networks". In addition, with the increase of 3G and 4G construction efforts, the large-scale expansion of metropolitan area network is imperative! However, it must be noted that the construction of metropolitan area network abroad is mainly based on the air-blown micro cables technology. In 2001, the micro ducts and micro cables technology was introduced to China by Plumettaz S.A. With the joint efforts of domestic peers, the technology was formally put into commercial use in 2005. In the first half of 2005, China Unicom adopted air-blown micro cables in the whole 150km urban ring network communication line construction project of the Fifth Ring Road in Beijing. In the same year, Guizhou Telecom adopted nearly 150km micro cables in the construction of Guiyang urban ring network. In 2005, air-blown micro cables were used in all of the 1000km special network communication line for oil pipeline from Changling to Yizheng of Sinopec. In 2006, China Mobile applied the micro ducts and micro cables technology in the pilot construction of metropolitan area networks and access networks in some cities. Since 2007, China Mobile has used more than 2000 km micro cables in cities all over the country in the construction of metropolitan area networks and access networks.

## 3 Comprehensive Comparison between Optical Fibre Cabling System and the Cabling Technology with Air-blown Micro Ducts and Micro Cables

Traditionally, the flexibility and variability of the structured integrated cabling system are mainly embodied in the distribution frame; the information points of different physical locations can be connected with data or voice network equipment through flexible jumpers. However, after the cabling system is installed in place, the routing and cable types can no longer be changed or expanded. Compared with the traditional optical fibre cabling, the cabling system with air-blown micro ducts and micro cables has better flexibility. The main difference between the cabling system with air-blown micro ducts and micro cables and traditional optical fibre cabling system lies in the laying mode. The attenuation property of optical fibre itself is exactly the same as that of ordinary optical fibre, and connectors can be used for forming. The cost of the cabling system with air-blown micro ducts and micro cables is almost the same as that of the traditional optical fibre cabling system. The main advantages of the cabling system with air-blown micro ducts and micro cables are as follows:

### 3.1 Decentralized Investment Cost

At present, many users will not use all-fibre

network for cost reasons (including the related optical cables, termination, distribution frame, photoelectric conversion equipment, and laying difficulty) when considering the network system design. In many cabling projects, only a few information points adopt the scheme of "Fibre to the Desktop"; when the optical fibre signal needs to be added in the later period, the users will be troubled by the lack of proper routing for cable laying. In the cabling system with air-blown micro ducts and micro cables, since the cost of the micro duct is very low (less than one-tenth of the cost of the optical fibre), more micro ducts for air blowing will be designed as much as possible. In the later application, the optical fibre can be blown into the duct according to the actual needs, so that the investment cost will be decentralized and the burden of the user will be reduced.

3.2. Installation Safety

Little damage will be caused to the cable itself in the construction. Since the optical cable is blown into the micro ducts slowly with air blowing machine, the cable body will be uniformly stressed, the outer protective layer will not be damaged, and the cable core structure will not be damaged, thus ensuring that the transmission characteristics of the optical fibre will not be affected. In addition, since the optical cable blown into the micro duct is protected by the outer protective duct, the cable will not be easily damaged, which completely solves the problem that the optical cable is easy to be damaged by pulling, twisted and scratched in the construction of laying the optical cable by traditional methods.

3.3 Flexible and Advanced Configuration

With the development of computer technology, the demand of computer network for the number and types of optical fibres is also changing. For example, when optical fibres are used to support the latest Gigabit Ethernet, multimode optical cables that can support up to two kilometers of 100 Mbps Ethernet can only support up to 275 meters of transmission (using 1000 Base-SX interface that accounts for 90% of the market share). After the technology of cabling with air-blown micro ducts and micro cables is adopted, according to the requirements of the user network system, the required number and types of optical fibres (multi-mode, single-mode, enhanced multi-mode) can be blown into the empty duct at any time.

4 Common Products for the Cabling with Air-blown Micro Ducts and Micro Cables

4.1 Air-blown Optical Fibre Unit and Air-blown Micro Optical Cable

The diameter of air-blown optical fibre unit using optical fibre bundle includes two types: 1.1 mm (6 cores) and 1.7 mm (12 cores). Figure 1 shows a typical structure of air-blown optical fibre unit developed by YOFC. The diameter of all-dielectric central loose tube air-blown optical cable includes two types: 2.4mm (12 cores) and 2.7mm (24 cores). This cable adopts the structure of loose oil-filled tube with grooved sheath, and the metal-free structure design can effectively prevent radio frequency interference and electromagnetic wave interference. The specially designed compact optical cable structure and material selection can effectively prevent the tube from retracting. Figure 2 shows the central tube type air-blown micro optical cable developed by YOFC.

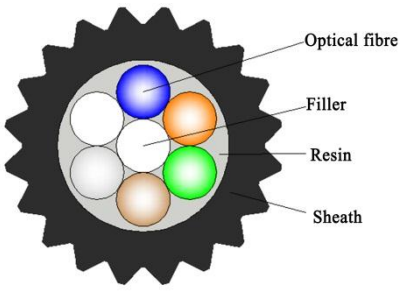



Figure 1 Air-blown Optical Fibre Unit

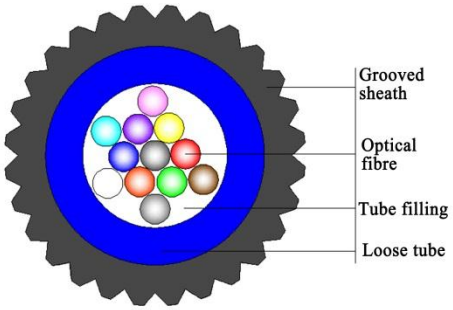



Figure 2 Central Tube Type Air-blown Micro Optical Cable

The above two kinds of air-blown micro optical cables are mainly suitable for FTTX projects because of their small number of cores and small diameter. The air-blown micro optical cable with large number of cores adopts the all-dielectric loose tube stranding type structure. Figure 3 shows a typical structure diagram of the air-blown micro optical cable with loose tube stranding type structure.

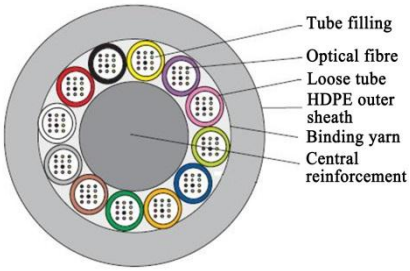



Fig. 3 Typical Air-blown Micro Optical Cable with Loose Tube Stranding Type Structure

4.2 Micro Ducts:

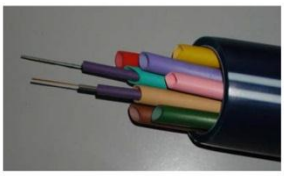
Micro ducts are an important part of the air blowing system, just like urban roads, which must be laid to the destination before the micro cables are laid, and must be laid in place at one time. Because of the problem of twisting, micro ducts in the same protection duct must not be laid in batches. At present, there are about three kinds of micro ducts in foreign countries according to their structures:

Bundled duct (see Figure 4): This duct is somewhat like the common honeycomb duct. It consists of the bundle of micro ducts and an outer sheath which will be assembled by the manufacturer. However, the micro ducts are not connected with each other and relative displacement is allowed. The advantage of bundled duct is that the density of the ducts is high enough to accommodate the largest number of micro ducts in the effective space. The disadvantage is its poor flexibility. The connecting of the ducts is not convenient, the bifurcation of inner micro ducts is difficult, and the ability to resist impact is also poor. The deformation of the protection duct can directly cause the deformation of micro ducts.

Figure 4 Bundled Duct

Micro duct bundle (see Figure 5): A certain number of micro duct bundles are blown into the laid protection duct with the super air blowing machine according to the inner diameter size of the protection duct. According to the air blowing principle, the micro duct bundle must not fill the whole duct, and there must be a certain gap between the micro duct and the protection duct, which ensures that the deformation of the protection duct will not directly affect the micro ducts. In addition, the air-blown micro duct bundle has flexible bifurcation and higher impact resistance. Since the air-blown micro duct bundle is loose in the protection duct, when the protection duct is impacted by the outside, the micro duct will have higher buffering capacity. At the same time, the air-blown micro duct bundle can make full use of the original duct resources to expand the capacity of the duct, especially in the old urban area and the areas where the duct resources are scarce. As long as you have an empty protection duct, you can expand your duct to

3-5 micro ducts. If you have no empty protection duct, our air-blown micro duct technology can also consider whether air-blown micro duct can be used and how many micro ducts can be blown based on the ratio of the inner diameter of your protection duct to the outer diameter of your optical cable.



Ø40/33mm protection duct
10 7mm micro ducts

Ø40/33mm protection duct
5 10mm micro ducts

Figure 5 Micro Duct Bundle

Combined micro ducts (see Figure 6, specially used for FTTB): Each group of combined micro duct consists of six 4mm micro ducts, without outer sheath. Four groups of micro ducts (24 ducts in total) can be laid at the same time in one 40/33 mm micro duct.

Figure 6 Combined Micro Ducts

4.3 Air Blowing Machine and Air Blowing System Accessories

A complete set of high-quality air blowing machine and micro duct accessories is essential to the air blowing system. At present, the air blowing machines and air blowing system accessories are mainly provided by Plumettaz S.A. (Switzerland), with a wide range of types. The main products include micro duct air blowing machines, micro cable air blowing machines, micro duct straight connectors, micro duct sealing end caps, micro duct adapter fittings, Y-connectors, T-connectors, duct plugs, Figarino cable baskets, air compressors, air coolers, special lubricants for air blowing, and so on.

5 Conclusion

The technology of cabling with air-blown micro ducts and micro cables is to lay optical cables in micro plastic ducts through air blowing. The construction speed is fast and the cost of laying optical cables is reduced. The micro cables laid through air blowing have high optical density and small diameter, and can be blown into the silica-core micro ducts with small diameter, so as to improve the utilization rate of communication pipes. The air-blown micro optical cables with high optical density and small diameter solve the problems of high investment cost for network construction and low optical fibre utilization ratio. It may not only reduce the initial investment but also realize gradual investment with the increase of customer needs, and the existing duct resources can be reused. It is especially suitable for such scenarios as FTTH and access network. With the economic development and technological progress of our country, the technology of cabling with air-blown micro ducts and micro cables will be used more and more in the communication network construction in the future.

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**长飞光纤光缆股份有限公司**
Yangtze Optical Fibre and Cable Joint Stock Limited Company
地址：武汉市光谷大道9号（430073）
ADD：No.9 Optics Valley Avenue, Wuhan, Hubei, China(P.C.: 430073)
电话(Tel)：+86 400-991-6698
邮箱(Email)：marketing@yofc.com
www.yofc.com