

# 高原制氧技术

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**摘要** 介绍针对青藏高原高海拔低气压环境而设的医用制氧站变压吸附式制氧原理和制氧技术。

**关键词** 青藏高原 制氧 医用制氧站

## 1 前言

青藏高原海拔高、气压低、氧分压低,从低海拔地区来参加青藏铁路建设的人高原反应达 100%,高原病发病率 66%,深受缺氧折磨,严重者甚至不能正常工作。在青藏铁路建设一线,氧气成了建设者们必不可少的后备物资,氧气也是青藏铁路建设的医疗保障。十六局集团公司承建的第 16 标段,地处高原腹地、唐峰脚下,海拔 4 700 m 以上,空气含氧量比平原地区低 45% 以上,氧气更是必备品。上场伊始,我局指工地医院就购置了价值 70 多万元的制氧贮氧设备,安装了高压氧舱和氧吧,还源源不断地向各项目部施工队提供瓶装氧气,有力地保证了施工的顺利进行。下面介绍我制氧站用中国龙飞集团有限公司医用变压吸附式制氧机高原分子筛分式制氧技术。

## 2 制氧原理和变压吸附技术

以空气为原料,应用气体分离技术,在常温条件下加压吸附、减压解吸的循环过程,以分子筛为吸附剂,在常温低压条件下,采用变压吸附技术,将空气中的氧气、氮气分离并滤除有害物质制取医用氧气。

我们生活的大自然空气中,氧气占 21%,氮气占 78%,其它气体占 1%。空气经空压机加压后进入空气贮罐,然后经冷冻进入高效除油过滤器,再经多级过滤除去空气中的杂质和可能带的油、水蒸气,通过切换阀进入充满沸石分子筛的吸附器。在吸附器内,空气中的  $N_2$ 、 $CO_2$  等被分子筛吸附,氧气从吸

附器上部进入氧气贮罐,产出氧,废气通过消音装置排向大气。

## 3 龙飞制氧设备的工艺流程

龙飞制氧设备由空压机、冷干机、空气贮罐、分水滤气器、空气缓冲器、多通旋转分配阀、吸附塔、氧气缓冲器、流量计和程序控制器等组成,见图 1。

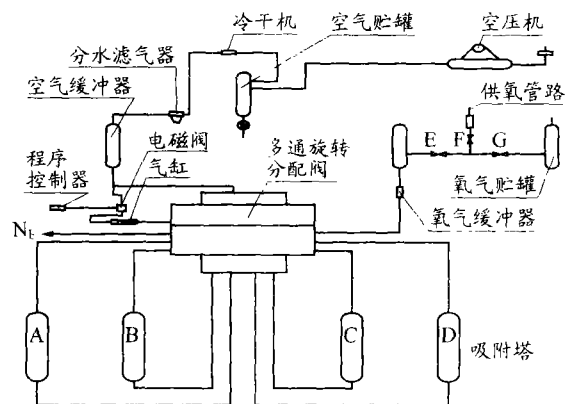


图 1 龙飞制氧机构造

空气通过空压机加压,经空气贮罐、冷干机、分水滤气器进入空气缓冲器,经电磁气阀,通过多通旋转分配阀(它以气缸作动力,由程序控制器控制)分送到吸附塔,在吸附塔里氧、氮被分离,氮气经多通旋转分配阀排氮口放空,氧气经多通旋转分配阀进入氧气缓冲器然后输往中心供氧系统连接管路

氧产品的理化指标:

- (1) 氧浓度  $\geq 90\%$ ;
- (2) 水分含量  $\leq 0.07 \text{ g/m}^3$ ;
- (3) 二氧化碳含量  $\leq 0.01\%$ ;

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# 青藏铁路医疗卫生保障工作初探

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**摘 要** 阐述了青藏铁路医疗卫生保障的根本原则,介绍了做好医疗卫生保障工作的关键措施。

**关键词** 青藏铁路 医疗卫生 保障

我局承建的青藏铁路第 16 标段,海拔 4 700 ~ 4 850 m,处于低气压、低氧、低温、寒冷、干燥、多风、强日光辐射和自然疫源性疾病多发等恶劣的自然环境。如何在这特殊、恶劣的环境中做好医疗保障工作,保证员工以良好的身体状况投入到施工一线,结合工作实践作了一些初步探索。

## 1 建立和完善卫生保障体系是前提

完善医疗保障措施是中标承诺的主要内容,更是确保员工生命安全和身体健康的必备条件。我集团公司首先投资 300 余万元购置了先进的高压氧舱,制、压氧设备和现代化救护车及先进的临床检验设备;其次,从全局抽调 8 名技术好、思想过硬、整体

素质高的医务人员组成精干的工地医院,同时指挥部下属的各工区也相继组建了卫生所;第三,针对高原特点和施工现场实际制定出台了一系列卫生保障管理规章制度和措施,如《青藏铁路卫生管理办法》、《医务人员夜间查铺和巡诊制度》、《药品采购管理办法》、《病人后送管理办法》等,这些制度的贯彻实施对于做好员工的卫生保障工作起到了至关重要的作用。我们在落实日巡诊、夜查铺制度过程中做到“两勤”“两早”,即勤巡诊、勤观察,早发现、早处理,坚持 24 h 接诊制,无论白天夜晚、晴天雨天,医务人员都坚持 24 h 值班制度,做到随到随治疗、随到随抢救,保证伤病员能在 1 h 内得到及时有效的抢救治疗。

## 2 贯彻预防为主、综合管理的原则

坚持“预防为主”是做好卫生保障工作的一项主

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(4)一氧化碳含量应符合 GB 8986-88 中第五章规定,气态酸和碱含量应符合 GB 8986-88 中第六章规定,臭氧及其他气态氧化物应符合 GB 8986-88 中第七章规定;

(5)氧气应无气味;

(6)固体物质粒径  $\leq 10\mu\text{m}$ ,含量  $\leq 0.5\text{ mg/m}^3$ 。

制氧过程应注意事项:

(1)环境温度 5 ~ 40 °C,相对湿度  $\leq 80\%$ ,大气压 86 ~ 106 kPa;

(2)电源频率 50 Hz  $\pm 1$  Hz,电压:三相为 380 V  $\pm 30$  V,单相为 220 V  $\pm 30$  V;

(3)制氧设备的空气源进口应位于污染最少的地方;

(4)检查空气过滤器差压指针位置是否接近红

区域,接近时应及时清洗或更换滤芯;

(5)检查空压机进气过滤网污染状况,每清洗过 5 次应更换新滤网。

## 4 成果

我制氧站每天可制氧气 5 000 L,氧气质量优良,符合国家质量行业标准。氧气供应做到随用随发。自 2002 年 5 月制氧站建成仅几个月就罐装 1 980 瓶,保证了集团指工地医院和下属各项目部的用氧。已有 36 位危重患者得到高压氧舱的救治,上百人进舱作保健治疗,有四百余人进氧吧吸氧,还为过路的 58 人灌瓶、充氧气袋。所建制氧站为第 16 标段千余名筑路大军的身体健康奠定了坚实的基础。

# RAILWAY CONSTRUCTION TECHNOLOGY

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## Abstracts and Keywords

### **Making great efforts for a first class plateau railway**

*Peng Jianghong*

**Abstract** An introduction is given to the general of Golmud-Lhasa section of Qinghai-Tibet Railway. A summary is given of technical measures for subgrade, bridges and culverts, and tunnels at permafrost zone, characteristics and difficult points of construction. An introduction is given to key points in health care and environmental protection over the plateau. Issues for further study and exploration were put forward.

**Keywords** plateau railway, frozen soil, construction

### **Construction of water-stop ridge for subgrade at permafrost zone** *Di Jianxuan, Nie Qingwen*

**Abstract** An introduction is given to design principles and construction method for water-stop ridge at permafrost zone over Qinghai-Tibet Plateau.

**Keywords** permafrost zone, water-stop ridge, construction

### **Application of low temperature early strength high performance concrete to Qingshuihe River Extra Large Bridge**

*Huang Zhijiu*

**Abstract** An introduction is given to the performance and preparation of DZ series of low temperature early strength high performance concrete and its application to Qingshuihe River Extra-large Bridge. It is regarded that the preparation and construction of this concrete is a system project, and emphasis should be laid on design of mixture ratio, curing of concrete, and related technological measures.

**Keywords** high performance concrete, design of mixture ratio, construction

### **Prefabrication of 8 m pre-tensioned prestressed concrete T beam at permafrost zone over plateau**

*Guo Peng*

**Abstract** Prefabrication of 8m pre-tensioned prestressed concrete T beam is a new technology successfully applied for the first time to extra-large bridge at permafrost zone over plateau. An introduction is given to mould design, concrete pouring, and prestress stretching.

**Keywords** permafrost zone over plateau, T beam, prefabrication

### **Construction of corrugated metal pipe culvert for Qinghai-Tibet Railway**

*Li Xiya, Cao Yuxin, Fang Lihui*

**Abstract** An analysis was made of why corrugated metal pipe culvert was adopted for Qinghai-Tibet Railway. An introduction is given to construction of the culvert, including foundation for the pipe, arrangement of entrance and exit, installation of pipe segment, and soil filling on top of the culvert.

**Keywords** plateau Railway, corrugated metal pipe culvert, construction

### **Smooth blasting technology for a tunnel in frozen soil**

*Qiu Fa*

**Abstract** An introduction is given to characteristics of smooth blasting for tunnels in frozen soil, and selection of parameters, pattern of blast holes, and design of explosive charge.

**Keywords** frozen soil tunnel, smooth blasting, construction

### **Construction of Fenghuoshan Tunnel with thick underground ice** *Liu Wanqi*

**Abstract** An introduction is given to construction technology for Fenghuoshan Tunnel with thick underground ice, including excavation of the open-cut tunnel, tunnel construction in warm season, rail haulage, shotcreting, and full-face laying of heat-insulation slab.

**Keywords** froze soil tunnel, thick underground ice, construction

### **Quality control over the construction of high durability concrete** *Su Qingguo*

**Abstract** An introduction is given to whole process quality control of high durability concrete, including selection of raw materials, preparation of the concrete, transportation, pouring, and curing of the concrete under the extremely bad natural conditions of Qinghai-Tibet Plateau.

**Keywords** plateau Railway, high durability concrete, application

### **Application of high performance concrete to construction of Qinghai-Tibet Railway**

*Zhu Weidong*

**Abstract** An introduction is given to construction method for high performance concrete, including control measures for raw materials, mixture ratio, and construction process.

**Keywords** plateau Railway, high performance concrete, construction

### **Difficult points for health care of Qinghai-Tibet Railway project and countermeasures**

*Zhu Tongchun, Liu Jingliang, Chai Zuochun, Yu Guoshu, Dong Weiya, Tu Baokun, Fang Zhonghou*

**Abstract** An introduction is given to three difficult points in health care work of Qinghai-Tibet Railway: severe natural environment, natural epidemic source of pestilence, and no clean drinkable water is available. Emphasis should be laid on four aspects, attaching great importance to people's health, establishing a sound health care system, carrying out training about health care knowledge over the plateau, doing a good work on physical examination and acclimation.

**Keywords** plateau Railway, health care, countermeasure

### **Technology for oxygen making over plateau**

*Li Dequan*

**Abstract** An introduction is given to the technology for oxygen making over Qinghai-Tibet Plateau with high altitude and low air pressure.

**Keywords** Qinghai-Tibet Plateau, oxygen making, oxygen station for medical use