HYPOXIC CHAMBERS - THE USE OF HVAC SYSTEMS IN PROVIDING SPECIFIC TRAINING CONDITIONS OF ATHLETES

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ABSTRACT

Hypoxic chambers represent a significant advancement in simulating high-altitude conditions for athletic training, medical therapy, and physiological adaptation. Originating from HVAC technology, these controlled environments reduce oxygen concentration or atmospheric pressure to replicate elevations up to 6,500 meters, enabling users to train or adapt without leaving sea level. This paper outlines the physiological basis of hypoxia—oxygen deprivation in tissues—and explores its applications, including hypoxic training, intermittent hypoxic therapy, and the use of hypoxic tents. Various technological methods for generating hypoxic air are examined, such as nitrogen membrane separation, pressure swing adsorption (PSA), synthetic gas mixtures, and hypobaric simulation. Each approach is evaluated for its operational efficiency, environmental impact, and technical limitations. The environmental considerations of hypoxic chambers, particularly the use of refrigerants and electricity, are discussed within the context of EU and global regulations, including the F-gas Regulation and the Montreal Protocol. While these chambers offer great potential for performance enhancement and acclimatization, their further development must balance functionality with ecological responsibility, encouraging innovation in sustainable HVAC solutions.

Keywords: HVAC, air conditioning, ventilation, hypoxia

INTRODUCTION OF HYPOXIA

Training in hypoxic conditions has long been the domain of professional athletes, high-altitude climbers, and astronauts. Traditionally, it required staying at significant levels, which involved costs, limited control over environmental conditions, and the risk of negative health effects. The solution to these problems is hypoxic chambers – enclosed spaces with controlled atmospheric composition that simulate high-altitude conditions without the need to travel to mountainous areas.[1]

Hypoxic chambers are an extremely innovative and practical solution derived from the HVAC industry, which has taken sports training to a completely different level. These chambers can be standalone training buildings, part of a fitness club, or even installed in the comfort of our homes. Modern technologies allow us to reduce both pressure and oxygen levels to simulate conditions found on the world's highest peaks.

Hypoxia is oxygen deprivation in the body, specifically a deficiency of oxygen in body tissues, meaning that cells do not receive enough oxygen to function properly. It is a condition where the oxygen partial pressure in arterial blood falls below physiological

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