DESIGN AND ANALYSIS FOR SCREW COMPRESSOR

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ABSTRACT: *This paper deals with the design and analysis of screw compressor. The twin-screw compressor is a positive displacement machine used for compressing air to moderate pressures. It comprises of a pair of intermeshing rotors with helical grooves machined on them, contained in a casing which fits closely around them. The rotors and casing are separated by very small clearances. The rapid acceptance of screw compressors in various industries over the past thirty years is due to their relatively high rotational speeds compared to other types of positive displacement machines which make them compact, their ability to maintain high efficiencies over a wide range of operating pressures and flow rates and their long service life and high reliability. Every time generation of different profiles and evaluate performance of those profiles by experiments is very difficult and these are expensive and time taking process. By using CFD can find out performance of different profiles easier. A suitable procedure for optimization of the screw compressor shape, size, and dimension is described here, which results in the most appropriate design. Compressors thus designed achieve higher delivery rates and better efficiencies than those using traditional approaches.*

Keywords- ***Rotor, Screw compressor, Tooth profile, Clearances, Solid Works, CFD***

I: INTRODUCTION

Gas compressors are mechanical devices used for raising the pressure of gas or vapour either by lowering its volume (as in the case of positive displacement machines) or by imparting to it a high kinetic energy which is converted into pressure in a diffuser (as in the case of centrifugal machines). The classification and use of compressors are described in the next section.

The selection of compressors for different applications is a crucial issue in the process industry. It is usually the most expensive piece of equipment and has dominant influence on cycle efficiency. The common types of compressors used in industry are reciprocating, twin screw, single screw, centrifugal, scroll and rotary vane. Compressor manufacturers are used to having a large market potential. Probably all types of compressors can be improved over what is available in the market today but the potential return must justify the expense of research and development to achieve the improvement.

Screw compressors of the type that is employed in the process and gas industries are large and expensive, while their continuing function is usually essential for continuation of the entire process in which they play a part. The reliability of their operation is thus at least as important as their efficiency. In the past few years, significant advances have been made in the design and manufacture of the main components of machines of this type, such as the rotors and the bearings, as well as lesser components. These have resulted in previously unthinkable improvements to both performance and reliability that has been widely applied to both air and refrigeration compressors. Despite this, process gas compressors have not yet widely benefited from these advances because, for these applications, the numbers produced are far fewer and they have a far longer development cycle than other compressors. Thus, improvements in process gas compressors are now overdue. Moreover, experience already gained in other applications can be incorporated at the design stage, with the minimum of added development time and cost, by simultaneous consideration of all the relevant variables that affect their operation.

II: LITERATURE REVIEW

1. Rotor Profile Design for Twin Screw Compressor

P.Jenno Xavier, K.Kanthavel, R.Uma Mythili.

Increasing demands for efficient screw compressors requires economic and high efficiency rotor designs of screw compressor. In order to design a effective rotor rack has to be generated effectively. Numerical and equation adopted in this paper leads to design a effective rotor profile. The solution obtained depends only on the parameters of the rack, pitch, addendum height, de dendum height ,rack co ordinates and meshing condition. A suitable procedure for optimization of the screw compressor shape, size, and dimension is described here, which results in the most appropriate design. Compressors thus designed achieve higher delivery rates and better efficiencies than those using traditional approaches.

2.Compressor Efficiency Definitions

K. Ueno, PhD, and R. E. Bye, VAIREX Corporation
K. S. Hunter, PhD, University of Colorado
May 12th, 2003Many standard effciency definitions exist that qualify the mass flow and power performance characteristics of a compressor. These different definitions are often used interchangeably throughout the compressor industry, although each is based on fundamentally different assumptions. This often results in incorrect comparisons between compressors offered by different companies, which precludes the customer from obtaining a fair and accurate assessment of their compressor needs.Here, we present a brief description of some effciency definitions to aid in understanding diferences between them. To do so we frist introduce a simple theoretical thermodynamicmodel of the compressor, and characterize its states during operation.

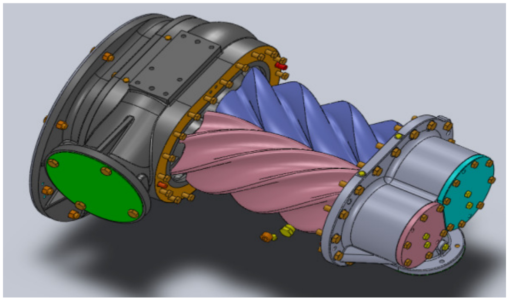
3. Calculation of Rotor Interference in Screw Compressors

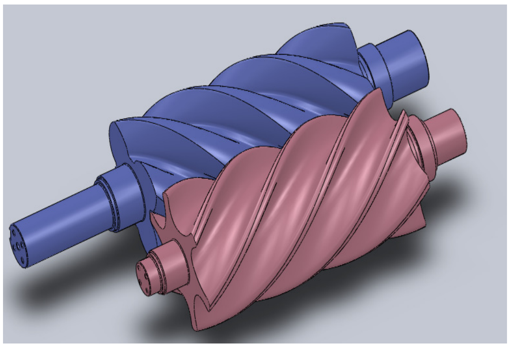
Professor N. Stosic, Professor Ian K. Smith and Mr A. Kovacevic

Small rotor clearances are today a vital prerequisite for an efficient screw compressor. The clearances are responsible for compressor leakages, small clearance will minimize them and thereby increase both, the volumetric and adiabatic efficiency. A continuous improvement in the rotor manufacturing equipment has been achieved during the recent years and tight production tolerances may now be applied to compressor rotors. This imposes a newapproach upon the design of compressor elements, such as the rotor and bearing housings and bearings to respond properly to this challenge. A mathematical apparatus to quantify a change in rotor position in screw compressors due to the bearing clearance and the imperfections in compressor housing manufacturing is presented in this paper an applied for identification of their significance and influence upon the screw compressor behaviour. The analysis based on this approach has shown that the change in rotor position may have negative, either static or dynamic effects on the compressor efficiency, safety, endurance and reliability and enhancing compressor noise.

III: MODELING AND ANALYSIS

Modelling: After performing simple calculation, the modeling has been performed on the Solidworks 2009 version and then after the analysis work has been performed on the ANSYS 12.0 version





IV: CFD Analysis

3D Model of Rotary Air Compressor Cavity is generated in SOLIDWORKS 2009 as per above given Drawing.Our CFD Analysis method is Cavity Patten so we have to create Cavity model of above Rotary Air Compressor Cavity.

- Import above Cavity model in ANSYS Workbench Mesh Module.

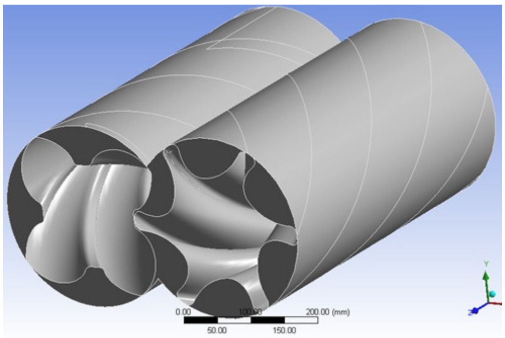


Figure 1. Cavity model

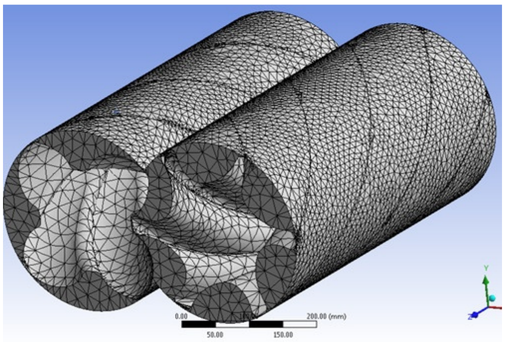


Figure 2. Mesh module

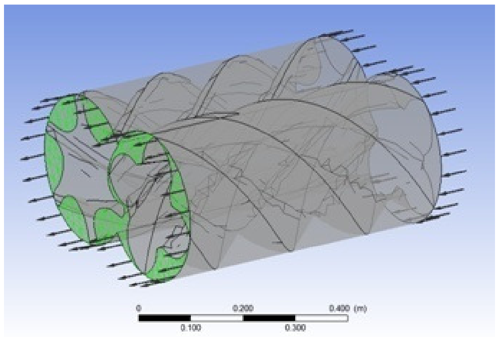


Figure 3. Rotary air compressor cavity model with inlet and outlet

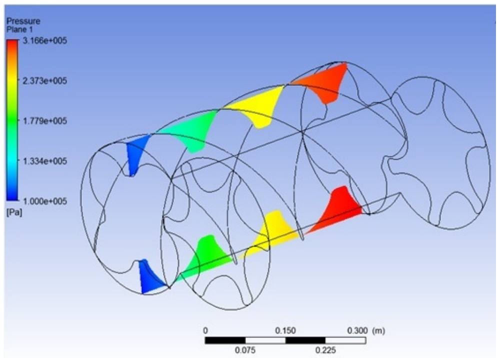


Figure 4. Pressure contour

Comparison of CFD Analysis Results with Experimental Results

	CFD Analysis(bar)	Practical(bar)	% Deviation
Pressure	3.910	3.8	2.6

VI: CONCLUSION

The performance of process air screw compressors is highly dependent on their rotor profiles and clearance distribution. While generation of Asymmetric “N” profiles consists of more curves care should be that while generation of faces. If more the number edges to make screw compressor profile number of faces are more to make 3-D geometry. We have to reduce number of edges such way that optimize the geometry. The clearance flow rate is non-linearly proportional to the pressure ratio across the rotor casing assembly. We have found out pressure variation around the rotors.

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[12] Professor N. Stosic, Professor Ian K. Smith and Mr A. Kovacevic Calculation of Rotor Interference in Screw Compressors
[13] K. Ueno, PhD, and R. E. Bye, VAIREX Corporation K. S. Hunter, PhD, University of Colorado Compressor Effciency Definitions