The project is a combined analytical and experimental programme to investigate the feasibility of the Organic Rankine Cycle principle for waste heat recovery in industry. In this report the main objectives and the work programme are described.

Some analytical investigations have preliminary results, such as our study about the potential of waste heat in industry usable by ORCS and the determination of the three most typical ORC-plants to be planned more detailed. There will be one plant in the petrochemical industry, one in the ceramic industry probably and one for using the thermal energy of Diesel-engine exhaust gases.

First results of the investigations in the experimental programme are given, too. Some details about thermal stability of R 114 can be described as well as the experience gained with the test loop during the experiments with R 114.

The characteristics of the different heat exchangers in the test loop are discussed and compared with theoretical values.
1. The main Objectives of the Project

Our project is a combined analytical and experimental programme to investigate the feasibility of the Organic-Rankine-Cycle principle for waste heat recovery in industry.

There is a lack of information about the potential of industrial waste heat usable by ORCS as well as the application of organic fluids as a working media in an ORC. Since there is only a limited amount of information available in the relevant upper temperature ranges concerning the behaviour of the fluids and the adapted technical components in the ORCS, we concentrate our investigations in these ranges.

The economy of waste heat recovery in ORCS depends greatly on the selection of the appropriate working fluid because its cost factor could be near the half-mark of the investment costs for the total plant. Therefore we have to investigate and compose the criteria for determining the most suitable fluid for any application in an ORCS. On this basis, the representative items of design of the technical construction of the whole ORCS and its components are given. An ORCS and component analysis is conditional for the definition of the data, which can thereafter be used as a basis for an extrapolation to other power ranges interesting.

A further essential point in our investigations is the economical description of the waste-heat-recovering-ORCS, together with a cost sensitivity study.

2. Work Programme

2.1 Analytical Investigation Programme

Our analytical investigation programme consists of the following activities:
- The identification of typical operational requirements for the working fluids, for the representative items of design and the cycle and components analysis
- The collection and evaluation of basic data for the design of ORCS for any waste heat recovery in industry, and the execution of the planning of the three most typical ORCS plants
- The collection of data concerning the potential of industrial waste heat usable by ORCS, and the specific part of the energy used by ORCS as compared with the total of the energy consumption in the industry.
- The investigation of the economical constraints in order to evaluate the economics and the cost sensitivity of design parameters.

Some results of these activities can be given, as follows:

Requirements for the fluids and lubricants
- Thermophysical Requirements

One of the fundamental criteria for the design of an ORCS is the maximum waste heat temperature. The selection of the working fluid depends mainly on this criterion. In order to have a low system operating pressure the working fluid should have a relatively high boiling point in comparison with the maximum waste heat temperature.

Another desired property is a good heat transport coefficient in order to minimize heat-exchanger surface areas.

A third criterion is the slope of the saturated vapour line. Organic fluids with a high molecular weight and a low number of atoms per molecule have positively sloped saturated vapour lines. Therefore, the vapour of these fluids is superheated at the exit of a turbine, and requires a recuperator to increase the system efficiency.