3.4.1. Sail windmill rotor

Relatively low speeds and special applications

The high-tech rotors of modern large wind turbines tend to draw the attention of millwrights to very streamlined rotors. They are usually intended to generate electrical power. They usually have a high-speed speed of at least 5.

For such high-speed applications, canvas rotors are not the first choice. Such rotors turn only 30-60 times per minute. For piston pumps, diaphragm pumps, chain pumps or screw conveyors, this speed is this speed is appropriate.

The KUKATE sail rotor has a high speed of approx. 1-1.5. For a power generation then usually a gearbox must be installed between the rotor shaft and the generator shaft to increase the speed.

Hope for many designs

Unfortunately, also the self-builders of water pumps have often put the many advantages of old rotor concepts to the files. We at OPEN WINDMILL do not want that here. We are already looking forward to the experience and success stories of the operators who build and operate canvas wind turbines.

With the following remarks we first describe how they are built. The practical hints and handouts we present under point 4.4.1 "Sailing windmill rotor" at the "Construction plans we offer".

Spars made of wood or metal.

A sail windmill does not have rotor blades of the usual design mounted. The torque of the rotor is generated by means of sails. These are mounted on spars.

Six sails turn the rotor shaft

At the rear end (for sailors: the clew), the cloth sections are attached with a short rope attached to the circumferential rope at a certain point. The circumferential rope is taut between the ends of the spars. It also adjusts the uniform distance between the spars. The short rope between the clew and the circumferential rope allows the rotor sail to blow out behind the tight „circumferential rope circle“. This creates an angle of attack to the airflow. The longer the rope, the greater the angle of attack.

In normal operation, the lift created by the camber keeps the sail taut and cambered like a ship's sail.

Good for a pump: A high starting torque

Another advantage is the greater width of the profiles at the outer circumference. They generate a high torque at startup and low wind speeds. This is very desirable for pumps, because from standstill the static friction must first be overcome. As the wind increases, the wing depth on the outside is - compared to the aerodynamic ideal profile - is too large and the pump is protected.

Plenty of scope for adjustments and experiments

There are many adjustment possibilities depending on the application and wind. If you choose a rubber band for the connection between the clew (the free corner of the sail) to the circumferential rope, it tightens more and more as the sail rotates faster due to the buoyancy force. At a certain stretching length of the rubber band, the current breaks because of the angle of attack is then too steep, and the rotor does not speed up.

THIS IS A PERFECT AUTOMATIC STALL CONTROL.

Simple influencing of the performance

If the rotor can be constantly monitored, the power can also be controlled by reducing the number of sails control. The sails are then connected with a detachable connection to the spar and the circumferential bracing connected.

Another way to reduce the power is to partially wrap the sailcloth around the spars. Wrapped.

For the last two methods of power control, however, we suggest a mast height of only 4.5m or 6m and a large working platform at the top of the mast. These procedures require a certain routine and also time.

Storm safety

If the wind gets stronger, it has a total of three safety systems:

1. The stalling flow in the outer rotor area in case of (too) strong wind due to the then too large wing depth at the ends limits the speed.

2. The rear bracing of the sail surfaces, which stretches in strong winds and is made of
rubber, which cause the current to break away, and

3. A side and rudder vane control, which turn the rotor out of the wind in a storm. If applied.

Wind vanes should also be applied

The alignment of the rotor can be done in two ways.

1. the wind turbine has a control vane of 2m² extended to the rear on a 4 - 5m long arm. This is rigidly connected to the nacelle. Such a control keeps the rotor always fully in the wind. The protection against overload is done by a stall on the sails.

2. the alignment is done in this way, as with all KUKATE34, by control and side vane. Thus the rotor is increasing wind further and further out of the wind.

THE CONSTRUCTION

The construction of the whole rotor consists of the rotor hub of the KUKATE34 modified for the sail rotor, the spars (wood), the sails and their rigging. The exact construction is described under the bullet point 4.4.1 (hyperlink to 4.4.1 KUKATE34 rotor).
These rotors are suitable for many needs. In case of very strong winds, three sails can be easily removed.
But also otherwise there are considerably many variants to experiment with.