AC200-T Tension Controller Introduction

VEICHI

➢ Tension controller introduction

AC200T tension controller controls the output torque by automatic roll diameter calculation, thus keeping a constant tension. There is no need to install tension sensors, and there is no need to feed current position or the external signals of tension. In most applications, tension control can be achieved without the rotary encoder for speed feedback . Under winding and unwinding control, the tension can be accurately provided to promise the uniform of material thickness .

Formula：

T(torque)=F(tension)*D/2（force arm）

Undetr torque control mode, the constant tension or taper (varying tension according to the diameter) control can be achieved, as long as the roller diameter is calculated accurately.

➢Application

Slitter

➢Features

- Advanced torque identification algorithm, high output torque accuracy, and small torque ripple.
- Intelligent diameter identification, high identification accuracy, and strong ability to resist disturbance.
- Strong adaptability of winding / unwinding reel , smoothly start-up and stable tension at high and low speed.
- Built in professional friction compensation module, to fundamentally guarantee the consistence of front and back tension under material processing.

➢Special Function

Function	Defination
Taper Coefficient	In winding process, sometime tension needs to be reduced withthe roller diameter increasing, which ensures good moulding effect.
Auto roll change	There are rich auto roll changing functions in tension controller, achieving auto roll change at high speed without stop, which greatly improve the production efficiency.
Friction Compensation	There is dynamic / static friction compensation for mechnical system in tension controller, which could optimize the tension control effect and improve the stability and response speed of temsion system.
Zero-speed Tension	Tension controller could provide auto identification tension value for fileds at zero-speed, to promise the fields needs of different tension at zero speed.
Other Functions	braking signal output at stop, material broken detection, winding/unwinding frequency limit

➢Torque control concept

Control modes：

(1) Speed control (open loop / closed loop)

The physical target of speed control is the motor speed.

(2) Torque control (open loop / closed loop)

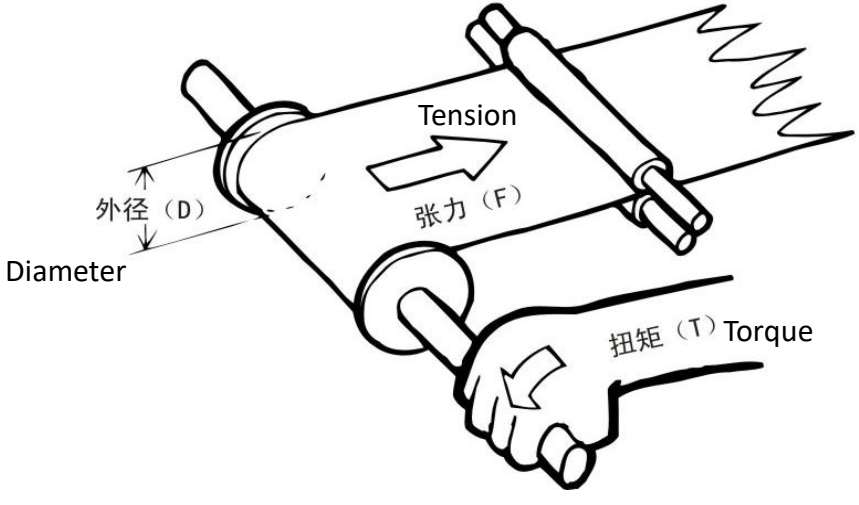
The physical target of torque control is the motor torque.

Torque mode refers to the inverter to control motor output torque, and the speed is related to the external load. Usually there is no speed loop, and only current loop in inverter, and external given is used as torque settings directly to the current loop. In order to prevent over speed, there is speed limit in speed outer loop with inverter. At this time, the speed loop acts only as a limit to the maximum speed, and the current loop still plays a leading role.

➢Torque & Tension

If we need a constant tension F, when the diameter D is constantly changing, the torque T also needs to change with the change of diameter D, so that the constant tension F can be guaranteed.

The relationship of tension (F), torque (T) and dismeter (D) is as follow:



$$\because \text{Torque}(T) = \text{Tension}(F) \times \text{Diameter}(D/2)$$

$$\therefore \text{Tension}(F) = \frac{\text{Torque}(T)}{\text{Diameter}(D/2)} = \frac{2 \times T}{D}$$

➢Taper control

The purpose of taper control: to achieve better molding effect, so that the material loose outside and tight inside.

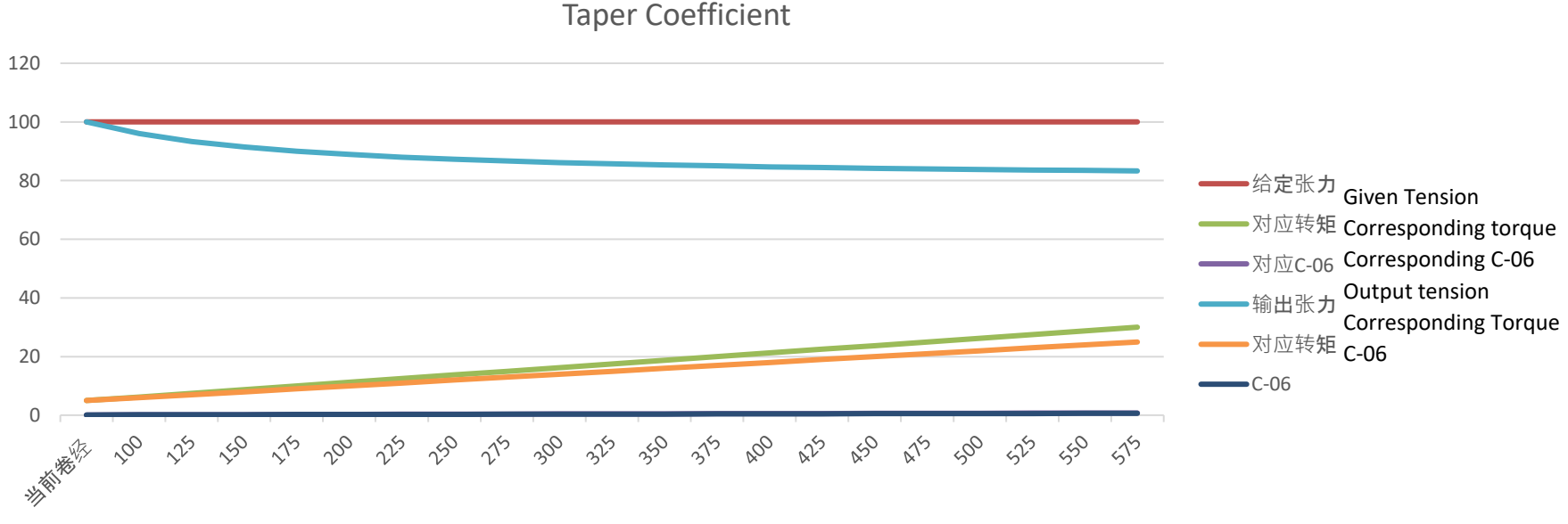
Reason: with the increase of winding diameter, the stress of material to the winding center will become larger and larger, leading to the extrusion of the inner ring by outer ring ,and bad winding molding effect .

Tension taper formular：

$$F_{output} = F_{given}\left[1-K\left(1-\frac{D_{initial}}{D_{current}}\right)\right]$$

➢Taper control

Note: Motor sample: 5.5KW, 4 poles, rated torque: 36.5N.m					
Parameter Setting					
Given Toruqe (N)	100	Taper Coefficient (%)	20.00%		
Initial Diameter (mm)	100	Taper Compensation Correction (mm)	0		
Motor Power (KW)	5.5	Motor Speed (R/min)	1400	Motor Torque	37.5



➢AC200-T Tension Controller - roller diameter calculation

Formula deduction of line velocity method：

V: Line speed of traction， : :The angular speed of winding reel, R: Winding diameter

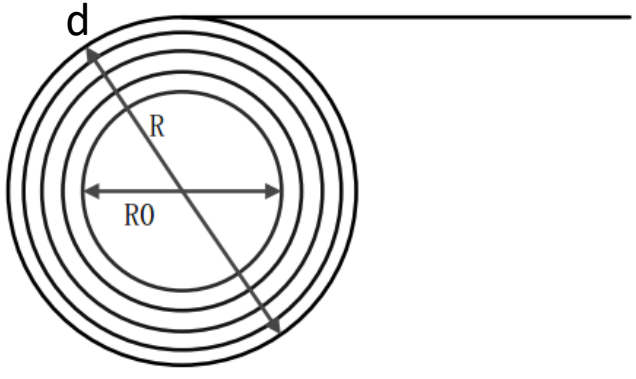
Formular of roller diameter calculation：

$$D = \frac{v \times i \times p}{60 \times \pi \times f}$$

v: current line speed, i: transmission ratio,p :motor pole pairs, f: current running frequency

➢AC200-T Tension Controller - roller diameter calculation

Formula deduction of thickness method:

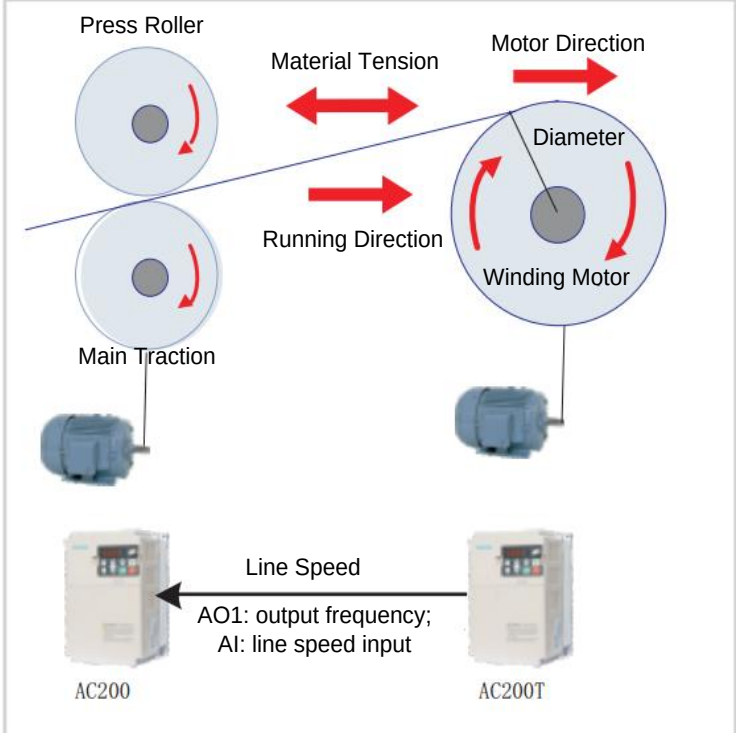


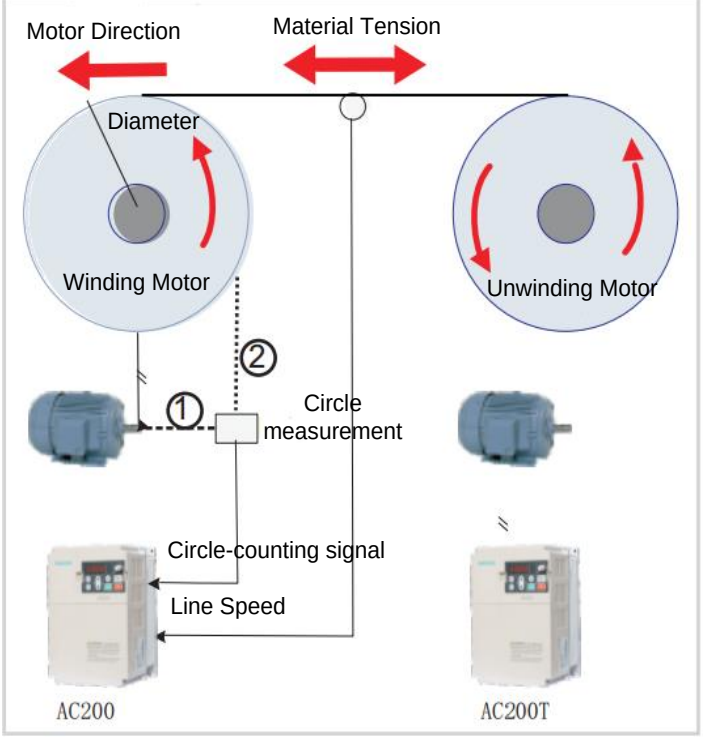
The winding diameter is calculated indirectly by PG card, photoelectric switch and external encoder ring.

The roller diameter changes with the increment value of 0.1mm, and the method is more stable than the circle calculation.

Winding： D=R0+2nd Unwinding： D=R0-2nd
R0: roller diameter (initial diameter), n: circle numbers, d: material thickness

➢AC200-T Tension Controller- System Solution





➢AC200-T Tension Controller - Debugging Notes

1. Deceleration ratio confirmation
(1) the deceleration ratio is calculated by the ratio of winding reel (empty volume) radius to winding motor shaft radius;
(2) the line speed of each frequency section is measured by the line speed velocimeter. Calculate current winding roller frequency according to the line speed and empty reel diameter. The deceleration ratio is the ratio of inverter output frequency to winding reel frequency .

2. Max line speed
(1) Calculate max line speed according to the max frequency of traction motor , the diameter of traction reel and transmission ratio.
(2) Measure the line speed of current frequency by line speed velocimeter, and then calculate maximum line speed according to the maximum frequency of traction motor;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R

Thank you

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