Design, Modification and Analysis of Concrete Mixer Machine

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Abstract:- This paper contains the study, design, modification and analysis of concrete mixer. Mixer widely used to make a concrete mixture which used to building construction and industry to make a concrete block, pipe, sheets, etc. it is observed that there is a failure of shaft and blade in mixer thus, deign modification and analysis of mixer have been done and presented.

Keywords: shaft design, computer aided design, mixer.

1. INTRODUCTION:

A concrete mixer is also commonly called a cement mixer, is a device that homogeneously combines cement, aggregate such as sand or gravel, and water to form concrete. A typical concrete mixer uses a revolving drum to mix the components. Today's market increasingly requires consistent homogeneity and short mixing times for the industrial production of ready mix concrete, and more so for precast concrete. This has resulted in refinement of mixing technologies for concrete production.

To supply continuously the ready mix its necessary that the concrete mixer should be in good condition of working, but it has been observed that the shaft and blade of mixer get failed after some uses of time. So in this project I am trying to identify the different causes of blade and shaft failure.

It was found that spun pipe manufacturing industry or industry related to manufacturing of cement or concrete product only concentrated on the geometrical properties of reinforced concrete. The geometric property of reinforced concrete is depends upon the proper ratio of input materials and also proper functioning of mixer machine. It is observed that the shaft of mixer machine bends due to overloading of input mixture and various forces acts on it. And thus mixer hopper rotated in oblong way thus, also the blades get break due to unbalancing of shaft. This results into low quality of concrete mixture.

Mixing is a complicated process that is affected by the type of mixer, the mixing cycle as defined by the duration, the loading method, and the energy of mixing.

For most machine shafts, however, analysis should be relatively straightforward. That’s because the failure typically provides strong clues to the type and magnitude of forces on the shaft and the direction they acted in, the failed parts will tell exactly what happened.

Drum:

A concrete mixer is a device that homogeneously combines cement, conglomeration such as sand or gravel, and water to form concrete. A typical concrete mixer uses a revolving drum to mix the components. Cement, sand and other aggregates are loaded in a hydraulically operated hopper and then poured in the mixing drum for final mixing and then can be unloaded by tilting the drum.

Specification:

Drum specification:
- Thickness of drum=3mm
- Upper rod thickness=16mm
- Upper dia of drum=509mm
- Middle dia=894mm
- Bottom dia=600mm
- Overall height=1000mm

Chassis specification:
- Upper length=970mm
- Lower length=1150mm
- Width=100mm
Motor specification:
- Electric motor 3HP
- RPM of motor=980
- Rpm of hopper or drum=760
- Pulley dia=555mm

Shaft:
Shaft of concrete mixer is mounted concentrically at the center of the Drum. Electric Motor, Metal Bucket/ the mixing trough, Shaft Pulley, Motor Pulley, Set of blades mounted on the shaft, Bearings, Shaft, Supporting Structures, V-Belt etc.

Position of shaft:

Specification:
- Material of shaft: Mild steel
- Length of shaft: 620mm
- Pedestal dia: 72mm
- Dia of shaft: 44mm
- Outer dia of thread: 37mm
- Inner dia of thread: 33mm
- Chamfer length: 155mm
- Bottom grease hole dia: 20mm
- Grease hole length: 360mm

Assembly design of drum and front view of shaft:

II. CALCULATION:

Mixing Force:
Mixing force is the Force transmitted through fluid during mixing action.
\[ F_{\text{max}} = 3\pi R_1 R_2 (n-y) \]
\[ = 3\pi \times 36 \times 22 (2.10-2) \]
\[ = 746.44 \text{N} \]
- \( R_1 \) & \( R_2 \) = Radii of shaft
- \( y \) = Shear strain rate (strain gradient)
- \( n \) = Plastic viscosity (0.02 Pas to 0.2 Pas i.e.0.2*10^{-10} to 2*10^{-18} Wsmm^{-3})

Torque=\( Pf/Ps/W \)
\[ = 373 \times 10^9 / 760 \]
\[ = 490.78 \text{N-mm} \]
- \( Pf \) = Power delivered by mixer during mixing
Ps = Power of empty mixer
W = Speed of rotation

Shear rate during mixing = E/M = n*y*t
- E = Mixing energy
- M = Mass of material

Mixing Energy of Cement paste:
E=P*T/3600*mixture volume
=2238*1/3600*2300
=772.25*10³J/sec
- P = Power (w)
- M = Mixing time (hr)

Torsion on shaft exerted by electric motor
T=60P/2]\[N
=60*2238/2 \[760
=28.12*10³N-mm

Stresses in shaft:

Shear stress due to transmission of torque
τ=16*T/ \[d³
=16.81N/mm².

Shaft subjected to twisting moment
Twisting moment (N-m)= T/J=τ/\[J
J = π/32 *d⁴

Bending stress:
Shaft subjected to bending moment:
M/I=σ/Y=E/R
- M = Bending moment
- I = Moment of inertia & cross-section area of shaft
- σ = Bending stress
- Y = Distance from neutral axis to outer most shaft

I=\[4/64*d⁴
Y=d/2
M=183.58*10⁹=206/22
M=1718.22
I=\[64*44⁴
=183.58*10⁹
Y=22
Ωb=425.43mpa

Shaft subjected to Combined twisting moment and bending moment:
T max =\[2\[\sqrt{\[σ²+4τ²}
=\[2\[\sqrt{183820.84}
=\[2\[\sqrt{428.74} = 214.37mpa.
III. LITERATURE REVIEW:

“Concrete Mixing Methods and Concrete Mixers: State of the Art Journal of Research of the National Institute of Standards and Technology. By Chiara F. Ferraris”. States that,
The efficiency parameter of a mixer are affected by the order in which the various constituents of the concrete are introduced into the mixer, the type of mixer, and the type and magnitude of forces on the shaft and the direction they acted in. and used to improve the mixing quality, to reduce the stirring resistance, to reduce the failure of shaft and blades and power consumption.

By Mr. Jamir A. Mulani1, Prof. Dr. S.H.Sawannt”. States that,
An efficient design of shaft could be achieved by selecting the proper variables, which are specified to minimize the chance of failure and to meet the performance requirements. and used to evaluate the behavior of components, equipment and structures for various loading conditions including applied forces, pressures and temperatures.

“3D Motion mixer for material: International journal of pure and applied research in Engineering & Technology.
By P. S. KULAT1, PROF. R. B. CHADGE “.
States that,
In order to improve both the Mixing and Time of mixing. Makes the surface layer known as the case significantly harder than the residual material known as the core. and used different materials using shaft and different types of blades to make a good quality homogeneous mixture.

By Thompson Aguheva”.
States that,
The machine was designed using AUTOCAD 2D/3D design software and proper material selection was done before the assembling and fabrication of parts. and used to avoid the bending of shaft, failure of other components of machine.

CONCLUSION:

1. Mixing is a complicated process that is affected by the type of mixer, the mixing cycle as defined by the duration, the loading method, and the energy of mixing.

2. For most machine shafts, however, analysis should be relatively straightforward. That’s because the failure typically provides strong clues to the type and magnitude of forces on the shaft and the direction they acted in. The failed parts will tell exactly what happened.

REFERENCE:

[9] 3D Motion mixer for material: International journal of pure and applied research in Engineering & Technology. By P. S. KULAT1, PROF. R. B. CHADGE.