SAVE YOUR CRUSHER MOTOR FROM BURNING THROUGH FLUIDOMAT FLUID COUPLING

A Crusher is typical equipment in Thermal Power Plants and Cement Plants. Crushers have a very large intertia and thus, require very long time to accelerate, specially, in loaded condition.

Condition - a
When motor is directly connected to crusher
Without Fluid Coupling

In this condition after a power failure or jammed Condition, the crusher is full with hopper and when tarted the crusher motor is strained tremendously.

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Motor draws a very high current in the range of 600 to 700% for a very long period of 40 to 200 seconds.

Result

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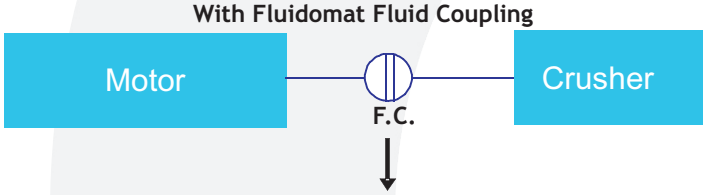
High risk of motor burning -
The risk of motor burning is multiplied several times if the system voltage falls down to 90% or 80% which increases the acceleration time by as high as 10 times thus straining the motor further.

Under above starting condition.

If motor protection is Set at high value	If motor protection is set at close value
Risk of motor burning	**Nuisance tripping,** **Makes Crusher starting difficult.**

Condition - b
When motor is connected to crusher
With Fluidomat Fluid Coupling



Risk of motor burning eliminated
Makes system fool proof.
Gives total safety against:
- low system voltage
- jamming of crusher
- Over loads and continuous shock loads

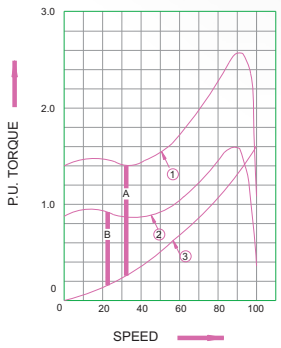
Provides easy starting of motor (because motor starts on no load.)

Thus Fluidomat fluid coupling on crusherearns money by eliminating motor burning, down time and production losses.

Consider example of a typical crusher to prove the above statement.

Motor	- 650 K.W. - 6.6 K.V. - 750 R.P.M. (Synch) squirrel cage Induction Motor.
Crusher	- 800 TPH rated, 960 TPH designed
Nominal torque	- 700 kgM.
System Voltage	- Anticipated between 100% - 80%
GD^2 Values	
Crusher	- 7120 kgM^2
Motor	- 300 kgM^2
Fluidomat Fluid coupling	- 200 kgM^2
Fluidomat Fluid Coupling Model	- SMD 15

TORQUE SPEED CURVE OF THE MOTOR



1. Torque speed curve at 100 voltage.
2. Torque speed curve at 80 voltage.
3. Fluidomat Fluid Coupling starting curve.

A Torque available for motor self accn. at 100 voltage

B Torque available for motor self accn. at 80 voltage

The Crusher motor current vs. speed and torque-speed curves at 100% to 80% voltage is as shown in fig. 2 The motor current is dependant only on motor speed with a definite corresponding value, if the voltage is constant. However, the current is proportional to voltage and if voltage falls down, the current falls down proportionally. Generally in crusher drives the voltage falls down to 80% value due to heavy inrush current during starting. The torque speed characteristic of motor at 100% and 80% voltage is shown in figure 1. Now, examine both the conditions of 100% and 80% voltages.

Without Coupling

(When Crusher is directly connected to motor) There is rigid connection between motor and Crusher and the two have to accelerate together. Therefore the torque generated by motor is utilised for accelerating self as well as for the high inertia load of crusher.

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Result

High acceleration time of motor and slow decay of motor starting current.

With Fluidomat Fluid Coupling

Motor starts on no load and torque available for motor acceleration (irrespective of crusher load) is the difference between motor torque characteristic and coupling starting torque charact eristic (fig.1) denoted by A and B. Accordingly the torque available for motor acceleration is tabulated in table 1.

Result

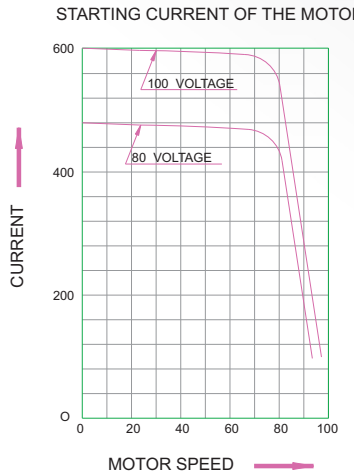
↓

Motor accelerates to 90% speed very fast and starting current decays to low value.

The torque generated by motor at different speeds at 100% and 80% voltage is also shown in the table. Figure 3 shows the decay of motor current with time for both the conditions of (a) and (b), and at 100% and 80% voltage.

Motor acceleration time under loaded condition as per the motor characteristics at 100% and 80% voltage can be calculated as per below:-

$$T\ Accn.\ (Time) = \frac{GD2 \times Change\ in\ RPM.}{375 \times Torque\ Applied.}$$



With Fluidomat Fluid Coupling

From the torque speed characteristics given in fig.1, the change in motor RPM is taken in steps of 10% and average torque taken in this speed zone. Motor nominal speed is 720 RPM. Therefore, the steps of speed change of 72 RPM is taken in calculation. Thus, for speed change from 30% to 40% the motor average torque is 1255 kgM and available for motor self acceleration is 1074 kgM and acc eleration time is 0.089 seconds.

With Fluidomat Fluid Coupling

At 100% Voltage:

$$T40\% = \frac{500 \times 72}{375 \times 1074} = \mathbf{0.089} \text{ seconds}$$

At 80% Voltage:

Similarly, if voltage has fallen down to 80% the acceleration time is = 0.163 seconds with average torque of 586 kgM available for motor self acceleration.

$$T40\% = \frac{500 \times 72}{375 \times 586} = \mathbf{0.163} \text{ seconds}$$

At 100% Voltage:

T Motor 40% = 1255 KgM - Crushing Torque of 700 KgM = 555 KgM.

555 KgM is the torque available for motor and Crusher acceleration.

$$\text{Acceleration Time} = \frac{72 \times 7420}{375 \times 555} = 2.56 \text{ Secs.}$$

At 80% Voltage:

T Motor 40% = 767 KgM - Crushing torque 700 KgM = 67

67 KgM is the torque available for motor and crusher acceleration.

$$\text{Acceleration Time} = \frac{72 \times 7420}{375 \times 67} = 21.2 \text{ Secs.}$$

Now, consider the heat generation in the motor during starting. If the resistive impedance of motor is Z_R then heat energy generated in motor is $I^2 \times Z_R \times$ Time. Thus, Comparative study of heat generated in motor at different values of current during the acceleration of motor and for 100% and 80% voltage can be made for both conditions (a) & (b)

TABLE I

Motor Speed % (1)	Torque Generated by Motor Tm (kgM) (2)		When Fluid Coupling in system Conditions (b)			When Fluid Coupling not in system Conditions (a)	
	At 100% V.	At 80% V.	Torque Transmitted by Fluid Coupling kgM (3)	Torque available for Motor self accn. (2-3) kgM (4)		Torque of motor utilised for Crusher and Motor accn. together Tm-T Crusher = (2) - 700 kgM (5)	
				At 100%V.	At 80%V.	At 100%V.	At 80%V.
10	1216	785	26	1190	759	516	85
20	1267	785	47	1220	738	567	85
30	1268	767	103	1165	664	568	67
40	1255	767	181	1074	586	555	67
50	1298	793	284	1014	509	598	93
60	1380	854	431	949	423	680	154
70	1518	957	612	906	345	818	257
80	1751	1104	819	932	285	1051	404
90	2044	1285	1052	992	233	1344	585
100	1526	1121	-	-	-	826	421

TABLE II

Motor Speed %	Motor Current 100%V. I_1%	80% V. I_2%	Accn. time of motor & Crusher together without Fluid Coupling (secs.) **Condition (a)**		Accn. time of Motor with Fluid Coupling (secs.) **Condition(b)**		Heating in Motor $I^2 \times Z_R \times$ Time DC without Fluid Coupling **Condition (a)**		FC with Fluid Coupling **Condition (b)**	
			100%V.	80%V.	100%V.	80%V.	100%V.	80%V.	100%V.	80%V.
0	600	480								
10	597	477	2.76	16.76	0.080	0.126	98.3	381.3	2.85	2.86
20	592	473	2.51	16.76	0.078	0.130	87.9	374.9	2.73	2.90
30	590	472	2.50	21.26	0.082	0.144	87.0	473.6	2.85	3.20
40	585	468	2.56	21.26	0.089	0.163	87.6	465.6	3.04	3.57
50	575	460	2.38	15.30	0.094	0.188	78.6	323.7	3.10	3.97
60	570	456	2.09	9.25	0.101	0.226	67.9	192.3	3.28	4.69
70	560	448	1.74	5.54	0.105	0.278	54.5	111.2	3.29	5.57
80	537	429	1.35	3.52	0.103	0.336	38.9	64.7	2.97	6.18
90	380	304	1.06	2.43	0.096	0.412	15.3	22.4	1.38	3.80
95	290	232								
96	180	144								
98	100	80	1.72	3.38	20	20	1.72	2.16	96.8	96.8
		Total	**20.67**	**115.48**	**20.828**	**22.003**	**617.7**	**2411.8**	**122.29**	**133.5**

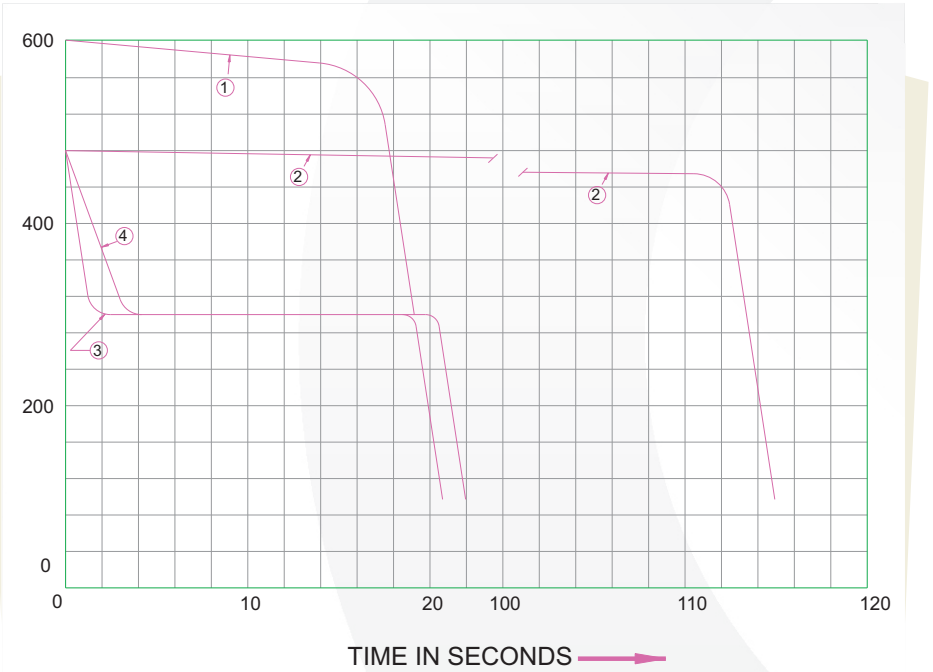
Ratio of Heating in Motor = $\frac{DC}{FC}$ **At 100% V. = $\frac{617.7}{122.29}$ = 5.05** **At 820% V. = $\frac{2411.8}{133.5}$ = 18.06**

The table II shows comparative data of motor current at various speeds, accn. time of crusher and motor and heating of motor for the drive system of with and without fluid coupling i.e., condition (b) and (a).

DECAY OF MOTOR STARTING CURRENT IN CONDITIONS :

When F.C. is not in drive system(curve 1&2) (a)

When F.C. is in drive system(curve 3&4) (b)



1. Without Fluid Coupling at 100 voltage.
2. Without Fluid Coupling at 80 voltage.
3. With Fluid Coupling at 100 voltage.
4. With Fluid Coupling at 80 voltage.

From the data in the table, it is clear that the heating in the motor is reduced by 5.05 times and 18.06 times respectively at 100% and 80% voltages by installing a Fluid Coupling. Thus, the motor burning risk is reduced respectively by 5 times and 18 times at 100% and 80% voltages. Since the motor starting current decays fast therefore, with a Fluidomat Fluid Coupling in drive, the motor protection can be set to closer value, further improving the safety of motor.

On sustained overloads, if the motor does not trip, then oil in the Coupling gets heated and the high Temperature Thermal Tripping arrangement trips the motor. Thus further safety of motor is ensured.

Fluidomat Fluid Coupling will limit the maximum torque transmitted and thus on overloads jamming the maximum torque experienced by motor will be limited to a predetermined safe value providing still further safety.

The above data and calculations demonstrate that motor burning risk is greatly reduced by the use of a FLUIDOMAT FLUID COUPLING.

SAVE YOUR CRUSHER MOTOR FROM BURNING
USE FLUIDOMAT FLUID COUPLING