Chapter 10

Active Monitoring, Machinery Example

ABSTRACT

Active machinery monitoring – continuous supervising, diagnosing, managing, controlling, compensating, documenting- is a process of acquiring and transferring streams of information (usually source information) about the analysed object, process, and relations between the same and the environment that can be used to realize the postulated state: knowledge creation (theory and innovation), environment melioration (harmfulness) and technical system optimization (design) - depending on technology needs and engineer imaginations. Knowledge creation comes as result of the creative action (creating). Melioration means the intentional activities of a technical system and boundary zone; activities that enhance, improve, and restore properties of the environment and not only limit technological harmfulness. Optimum comes in property of the machinery design (construction) or system state with respect to the criteria that enable rational evaluation of the state. Active monitoring, investigations into multi-disc grinders, demonstrate that it is possible to acquire knowledge of, describe and utilize, for design and structural purposes, the characteristics that indicate the relations between speeds, idle movement, loads and the indicators of motion variables in the grinding space. The objective of this example is to provide a mathematical description, optimisation of the states and changes in the grinding grains and machine space, their surface and volume during movement (idle and working movement) of the components, and design assemblies in the multi-hole grinding process.

10.1. MOTIONAL CHARACTERISTICS

Motional, usable characteristics and multi-disc and multi-hole grinding outcome variables: power demand ($P_R = f(n)$), degree of fineness ($\lambda = f(n)$) and mass target efficiency ($Q_m = f(n)$, $Q_c \le Q_m$) depend on the common area of the edges of two holes (S_c, S_T), density and volume of grain in the working space (ρ_m, V_g), rotational, angular and linear speed of a component and time ($n, \omega, v, \Theta, t_i$) - $L(P_R, \lambda, Q_m, Q_c) = P(S'_c, S_T, \tilde{\rho}_n^{m+1}, V_{\bar{g}}, n, \omega, v, \Theta, t_i)$; they also depend on the volumetric dosing of mass feed $q(0;1)$. The

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usable characteristics of grinding, dependent on the movement of grain and grinder components were named the motional characteristics of grain *(Flizikowski, & Co-authors, 2005; Flizikowski, 2011a; Knosala, & Co-authors, 2002; Niederliński, 1987; Sidor, 2006; Tomporowski, & Opielak, 2012; Zawada, & Co-authors, 2005; Ziemba, Jarominek, & Staniszewski, 1980).*

10.2. ASSUMPTIONS

To the active monitoring, determine motional characteristics of grain and grinder working unit, two states were assumed which are dependent on the linear speed of the grinding holes edges (Figure 1) *(Flizikowski, 2011b; Tomporowski, 2012b):* the first one – idle state, involving only movement and mixing, exclusive of grinding (linear speed of points on edges – below 0.7m·s^{-1}), second – working state, with significant grinding initiators (above 0.7m·s^{-1}). The characteristics have been formulated applying the following assumptions (*Flizikowski, & Co-authors, 2005; Macko, Boniecka,& Drop, 2011; Flizikowski, 2011b; Tomporowski, 2012b):*

- The number of contacts between grains, components and particles along their pathway influences the quality and grinding effects,
- The positioning of holes in respective discs of the grinding unit forms a line in the internal cone that starts on the initial diameter (*d*) with the pitch (*s*) and the length of the helical line (*c*), which increases by the thickness (*g*) and the number of discs (*n*) up to the length (*C*) – finished with an external cone of the hole edges,
- Movement, mixing and grinding of grains (p-m-r) depend, among other things, on friction conditions, structural features of discs and the positioning of holes in discs, with dynamic movement of the machine structural components and of grain ($p=p_m+p_z$) occurring during idle movement and when working load is applied to the machine ($p_m=p_j+p_r$), and of grains ($p_z=p_o+p_p$) during axial and radial movement within the hole and disc space,
- During movement and mixing of grain (p-m), apart from following trajectory similar to the helical line (original path), grains

Figure 1. RWT-5KZ multi-hole five-disc grinder working unit and space (Flizikowski, 2011b; Tomporowski, 2012b): a) grain filling in two adjoining working holes of the quasi-cutting unit: T_{n-1} do T_{n+2} – subsequent grinding discs, h^G – height of material column before the cutting plane, h^D – height of material column behind the cutting plane, V_g^G – calculated volume of material before the cutting plane, V_g^D – calculated volume of material behind the cutting plane, S_C – common area of the quasi-cutting pair of holes; b) cross-section of the multi-disc unit: 1 –bearing, 2 – grinding disc (so-called „preceding" disc), 3 – grinding disc (so-called "subsequent" disc), 4 – body, 5 – shaft, 6 – pulley