JM ProcessWise webinar
Secondary reforming air distributors (burners) problems and solutions webinar questions
November 2020

Questions and answers

Q1	I've seen JM also supply zirconia hexagonal tiles, are these also for secondary burners?
A1	Zirconia hexagonal tiles are usually used in auto- thermal reformers operating at much higher temperatures compared to conventional secondary reformers installed at ammonia plants where tiles made of alumina are usually used. Alumina tiles can well handle the duty so there is no need for zirconia tiles with very high melting point.
Q2	How do I know if the JM burner is suitable for my secondary reformer design?
A2	Upon receipt of an enquiry, the Johnson Matthey (JM) technical team will make an assessment whether we can offer a replacement burner into that particular secondary reformer, as there are certain types which are not suitable. However, where the JM technology replacement burners are suitable, it is a standard practice for us to offer customers tailor-made burners designed for a particular secondary reformer. Our partners can be confident that burners they purchase from JM will be suitable for their secondary reformers simply because the burners will be designed for them.
Q3	What causes the pink colour of the rubies when alumina recondenses
A3	Traces of chromium usually lead to the pink colour of the rubies when alumina re-condenses. The source of chromium is usually a material used for fabrication of an equipment upstream of the secondary reformer, or metal lining of the secondary reformer neck
Q4	Are there another way or tool to adjust the air to fuel ration manually from field beside flame shape, and colour which depends on operator experience and differ from operator to another?
A4	Secondary burner flames are enclosed within the secondary reformer and hence flame shape and colour are not applicable here. Please, also note that at ammonia plants the ratio between process air introduced to secondary reformer and the process gas can be varied in a very narrow interval if at all as Hydrogen/Nitrogen ratio exit the front—end of the plant needs to be 3.0 as dictated by ammonia synthesis reaction stoichiometry
Q5	What is standard life of a burner
A5	JM usually designs burners for 10+ years of the service life. In practice burners usually operate for a time period from 10 to 20 years, so the average service life can be assumed to be 15 years
Q6	How frequently do these burners need to be inspected
A6	We usually recommend an inspection every three or four years. No harm if the burner is inspected more often. Regular inspections every three or four years make it possible to detect damage on the burner if there are any.
Q7	What is the turn down limit of the burners
A7	Well, it's common knowledge that a typical turn down limit for an ammonia plant is approximately 65%. For secondary burners the turn down limit maybe lower. Taking into consideration that usually there is an option to introduce guard steam into the process air line, a part of the process air can be substituted with a flow of steam which will help to maintain the velocity through nozzles at the level when

	flames are lifted off from nozzles, so that nozzles are not subject to high temperatures, in this case the turn down limit for the burner maybe very very low.
Q8	What causes overheating if secondary reformer design for above 900 degree C
A8	If mixing is not good enough, hot zones may form within secondary reformer causing local overheating. This is what secondary reforming burners are designed for: to provide a high quality mixing without hot zones. In conventional secondary reformers process gas temperature inlet the catalyst bed is of the order of 1200 degrees Celsius, whereas the temperature in the hottest zone inside the flame can exceed 2000 degrees Celsius so you can see how important mixing is.
Q9	What is main difference of I'm burners to others
A9	Burners supplied by different companies have their own benefits. If a customer is interested in installing a JM burner we can work with the customer to provide details of the proposed design and benefits to be expected from the installation of a JM burner.
Q10	What is lead time of these burners if we need a new one
A10	Typically, it is 18 weeks from the date the order is placed
Q11	What is main failure of the burners
A11	Well, we should differentiate between a failure and a normal wear and tear. Our experience says that very often failures are caused by careless or handling of burners rather than operation. If for example, a top cover of the secondary reformer with a burner is removed not gently enough, a flow straightener may be damaged with formation of cracks between holes, or say, if the burner is knocked with a nozzle, it may lead to mechanical damage causing further accelerated burning out of this nozzle. If burners are properly handled we usually see very little damage caused by normal wear and tear, when we inspect the burners. End of life for a burner is typically associated with loss of metal associated either with metal dusting or high temperature operation. The design of the JM burner has been developed to be resistant to both of these mechanisms giving class-leading achieved lives.
Q12	What kind of inspection is recommended for the burner during turn around?
A12	Visual inspection of air distribution pipes, main welds, flow straightener plates and nozzles is usually needed, however our customers usually perform dye penetration tests of the main welds in addition to the visual checks
Q13	Hexagonal tiles are used only to protect catalyst from overheating, in any case tiles will be fused
A13	As hexagonal tiles have a very minimal catalytic activity for reforming, they can't protect catalyst from overheating they are used as a hold-down material preventing catalyst pellets from moving which leads to breakage. Hexagonal tiles have holes allowing process gas to penetrate through them so there is no way they can protect the catalyst below from high temperature as the catalyst in the very top of the bed in any case will contact with very hot process gas and will have the same temperature. As the gas moves down the catalyst bed the temperature will reduce due to reforming reaction which is highly endothermic
Q14	We use large support balls on the top of the bed. What are the benefits of using tiles verses large support balls.
A14	There are two main benefits of the use of tiles as hold-down materials compared to balls. Firstly, a singular tile is much heavier than a singular ball so tiles work better as a hold-down material, as well as the fact that it is much easier for a ball to be disturbed by the horizontal component of gas velocity at the surface of the bed than a tile. Secondly, the thickness of the layer of tiles is much less than the thickness of the layer of balls - this will allow for some more mixing space above the catalyst - this may be important for heavily loaded ammonia plants.
Q15	Please could you expand on what causes ruby formation?
A15	The mechanism of ruby formation is the evaporation of alumina from the very top of the catalyst bed and also the refractory lining of the secondary reformer with

	further re-condensation. If there are traces of chromium carried over from the equipment upstream of the secondary reformer or from secondary reformer neck lining, the re-condensed alumina will have a pink colour - this is what is called rubies. If there is no chromium there will be white deposit on the catalyst surface being just re-condensed alumina. It should be highlighted that alumina evaporation occurs in the very top of the catalyst bed, to a depth of 30 or 40 centimetres thickness.
Q16	How many air straightener plates is common for burners?
A16	We normally design the flow straightener on high-intensity KATALCO burner with two plates to ensure that the initial spiral trajectory of process gas flow completely converts to straight down flow, which is important for achieving good mixing.
Q17	Is there any way to tell if there are burner issues during operation
A17	As long as the ammonia plant is operating and there are issues with secondary reformer it is very difficult to say whether these issues take place due to the burner or the catalyst or the support system. There may be some indirect signs of the failure of the burner, such as pressure drop increase or methane slip increase, but it is impossible to identify the root cause of problems without opening the vessel and performing a thorough visual inspection of the vessel insides and the top cover with a burner
Q18	Are rubies caused by vaporisation of the catalyst?
A18	See above answer A15
Q20	How long do ring burners typically last
A20	JM usually designs burners for 10+ years of service life. In practice burners usually operate for the time period from 10 to 20 years so the average service life can be assumed to be 15 years
Q21	What's the difference between the single ring and double ring burners?
A21	Well, from the performance point of view both burners operate quite effectively. A double ring burner is usually recommended for secondary reformers with the neck internal diameter 0.9 metres or larger, whereas the single ring burner is more suitable for secondary reformers with smaller necks, of 0.85 metres and smaller
Q22	We won't know if the burner is damaged until we shutdown the unit, how quickly can you normally supply a new one.
A22	A typical lead time of the burner is 18 weeks from the date of the order but in our work with our customers we usually try to avoid such situations and if there is a need, we offer a replacement burner beforehand. Every time our partners report secondary burner damage, we always try to do our best to support and always provide an effective repairing plan for restoration of the burner.
Q23	We sometimes operate with different feeds to the primary reformer. Is one burner suitable for the different feeds.
A23	Different feeds usually affect the performance of primary reformer to a much greater extent than secondary reformer so, in general, it is likely that the burner will be suitable for different feeds. If our partner knows there is a need to operate at different feeds, it is usually reflected in the initial design basis of the burner so there shouldn't be any problem
Q24	If some nozzles are damaged, can individual nozzles be replaced?
A24	Yes, if necessary, JM can supply spare nozzles and also provide the procedure for replacement of individual nozzles.
Q25	What alloys are used in your burners?
A25	JM offers to customers tailor-made burners designed for a particular secondary reformer at a particular plant so you can be confident that the alloys will be the most suitable for the duty. The specific choice of materials of construction of the burner and welds constitute JM know-how, and therefore are not something we would disclose in a webinar.

Further information

Please contact your local Johnson Matthey representative for further information or send your enquiry to polly.murray@matthey.com